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# DELIVERABLE No: D4.1 Multidimensional performance measurement toolset for SCI models (SCI)

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# Deliverable Summary

**The challenge:** Health care systems worldwide face increasing pressure from the rising burden of preventable diseases and health inequities. Traditional funding models often prioritize reactive healthcare interventions rather than proactive models, capacity-building investments in prevention and health promotion. This fragmented approach leads to inefficiencies, increased healthcare costs, and missed opportunities to improve population health outcomes. A robust framework is needed to guide investments that enhance preventive healthcare and align stakeholder priorities through evidence-based decision-making.

**Aim:** This deliverable aims to develop a structured evaluation methodology, leveraging Multi-Criteria Decision Analysis (MCDA), to assess the effectiveness, efficiency, and equity of Smart Capacitating Investment (SCI) in order to support multi-sectoral decision-making in health and disease prevention. By integrating economic, social, and health outcomes, this framework provides a transparent and systematic approach to prioritizing investments that deliver the greatest societal impact.

**Methods:** The methodology for developing the SCI framework is based on **MCDA principles**, incorporating the following key steps:

- Criteria Definition: Establishing measurable and standardized indicators for evaluating SCI interventions, including health outcomes, cost-effectiveness, and societal impact.
- Stakeholder Engagement: Conducting workshops and consultations to align multiple interests and ensure that priority-setting reflects diverse perspectives, including those of policymakers, healthcare providers, and communities.
- Weighting and Scoring: Using structured techniques such as swing weighting and discrete choice experiments to assign relative importance to evaluation criteria.
- Performance Assessment: Comparing SCI interventions against predefined benchmarks, utilizing both qualitative and quantitative data sources.
- Deliberation and Decision-Making: Presenting findings through scorecards, dashboards, and scenario analyses, facilitating evidence-based discussions and consensus-building among stakeholders.

**Results:** The SCI evaluation framework supports the conduct of an objective and reproducible methodological approach to assess and prioritize investments in health promotion and disease prevention. By applying MCDA, the model ensures that interventions are evaluated across multiple dimensions, balancing cost, impact, feasibility, and equity considerations.

**Discussion:** The implementation of the SCI framework represents a paradigm shift in health investment decision-making, moving away from short-term cost containment towards long-term sustainability and impact. The structured approach enhances transparency, accountability, and stakeholder engagement, fostering a shared vision for preventative health initiatives. However, challenges remain in data availability, stakeholder alignment, and integration into existing policy frameworks. As a next step, the I4H team will continue refining the guidance based on its application in real-world test beds. Future efforts will focus on developing user-friendly materials, including training modules, digital tools, and policy briefs, to support broader adoption and ensure that SCI evaluation becomes an integral part of health investment strategies.

# Lay Summary

The Smart Capacitating Investment (SCI) Guidance is designed to help decision-makers invest in health promotion and disease prevention programs in a way that maximizes long-term benefits. Instead of spending money only on treating diseases, SCI focuses on building capacity—such as training health and care workers, improving community programs, and strengthening digital health tools—so that prevention efforts are more effective and sustainable. This guidance provides a clear way to evaluate different investments using a structured decision-making approach called Multi-Criteria Decision Analysis (MCDA). This method helps compare various options by looking at costs, health benefits, social impact, and fairness. The goal is to make smarter, data-driven decisions that ensure every investment contributes to better health, stronger communities, and a more efficient healthcare system. The SCI evaluation framework is continuously being refined through real-world testing, and easy-to-use materials are being developed to help governments, health organizations, and communities apply it effectively.

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# Glossary

| Acronym | Meaning |
|---|---|
| CA | Consortium Agreement. The management and regulatory framework from which the team works. |
| DALY | Disability Adjusted Life Year. The sum of years of potential life lost due to premature death and the years of productive life lost due to disability compared to a standardised life expectancy. One DALY represents the loss of the equivalent of one year of full health. |
| GDP | Gross Domestic Product. The total monetary or market value of all the finished goods and services produced within a country's borders in a specific period. It functions as a comprehensive scorecard of a given country's economic health. |
| GO Lab | Government Outcomes Lab, Oxford University. |

| | |
|---|---|
| MCDA | Multi Criteria Decision Analysis. MCDA is an evaluative tool for multiple conflicting criteria. It is a way of helping decision-makers rationally choose between multiple options where there are several conflicting objectives. |
| MRC | Medical Research Council. |
| NHS | National Health Service. |
| OECD | Organisation for Economic Co-operation and Development, an intergovernmental organisation with 38 member countries. |
| QALY | Quality Adjusted Life Year. It is the academic standard for measuring how well all different kinds of medical treatments lengthen and/or improve patients' lives. The metric has served as a fundamental component of cost-effectiveness analysis for more than 30 years. |
| ROI | Return on Investment. ROI measures the amount of return on a project relative to its cost. It is increasingly being used to evaluate the value for money of public health interventions |
| SCI | Smart Capacitating Investment. Task 2.3 uses the definition of SCI as constituting less conventional approaches to investment, financial or non-financial in health promotion and disease prevention initiatives that create returns somewhere along a spectrum between financial benefit on the one hand and the enhancement of the capacity or capability of individuals or communities to engage in healthier behaviour on the other. |
| SELFIE project | *Sustainable intEgrated care modeLs for multi-morbidity: delivery, FInancing and performancE* (SELFIE) project, (European Union's Horizon 2020 research and innovation programme, grant agreement number 634288). |
| SROI | Social Return on Investment. SROI is a framework for measuring and accounting for this much broader concept of value by incorporating social, environmental and economic costs and benefits. |
| Testbed | Regions in West Wales (UK), Skåne (Sweden), Galicia (Spain), and North Rhine Westphalia (Germany). |
| UK | United Kingdom. |
| WHO | World Health Organization. |
| WP | Work Package. |

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# 1 Introduction

## 1.1 Background

Smart Capacitating Investment (SCI) for health promotion and disease prevention aims to address multi-sectoral health challenges through capacity-building interventions. It aims to reduce preventable diseases, promote healthier lifestyles, increase community well-being, and address inefficiencies in fragmented systems by focusing on building capacity and resilience across sectors. SCI often extends beyond healthcare to include other governmental/economic sectors and community initiatives. Therefore, it is crucial for effective SCI to align stakeholders' diverse priorities and interests across the different sectors (e.g. healthcare, social care, education, and criminal justice). to ensure shared goals, foster transparency, and prevent conflicts that could undermine outcomes. However, evaluating the value created by SCI is challenging because the outcomes and costs across the sectors can be difficult to evaluate in the same framework as they are so different. Despite the widespread recognition of the need for cross-sectoral evaluations, there is a significant lack of standardized guidance on how to perform such analyses.

## 1.2 Relevance

Evaluating SCI in health prevention is complex, as their impacts span multiple domains such as healthcare, education, employment, and social services. Traditional evaluation methods, like Cost-Effectiveness Analysis (CEA) and Cost-Utility Analysis (CUA), often fail to capture these multidimensional benefits, highlighting the need for comprehensive frameworks. The importance of cross-sectoral evaluations is underscored by the Second Panel on Cost-Effectiveness in Health and Medicine, which introduced the "impact inventory" as a framework for systematically identifying and valuing costs and outcomes across multiple sectors. Simon Walker and colleagues have further elaborated on this approach, emphasizing its application to interventions where benefits extend beyond healthcare, such as education, employment, and social care. The "impact inventory" ensures that decision-makers can account for diverse impacts, such as productivity gains, reduced social service dependency, and broader societal improvements, facilitating a more holistic assessment of interventions. For instance, Walker’s work highlights the challenges of capturing non-health costs and outcomes consistently and the necessity of developing tailored methodologies for comprehensive cross-sectoral evaluation.

Concrete evaluation frameworks for cross-sectoral evaluation include Multi-Criteria Decision Analysis (MCDA), which has been used in the EU-funded SELFIE project to measure value of integrated care models in Europe for several stakeholders. Cost-benefit analysis (CBA) and the closely related social return on investment (SROI), are other examples of methodological frameworks that could foster multi-sectorial evaluation. For example, the Greater Manchester Combined Authority in the UK developed a CBA- based evaluation tool to measure the benefits of preventive health care for different stakeholders including local councils, health agencies, and private sector stakeholders. Another example of a cross-sectoral evaluation framework is the Green Book (UK Treasury) emphasize capturing costs and benefits comprehensively, including direct health impacts, productivity gains, and societal savings. In addition, the PECUNIA project developed standardized tools for cost and outcome measurement across European health and social care systems, highlighting methods for valuing informal care and lost productivity. For example, assessing a preventive intervention for alcohol addiction may include healthcare cost savings,

reduced criminal justice costs, and productivity gains, demonstrating the multi-sectoral nature of SCI impacts.

Such initiatives highlight the growing importance of cross-sectoral evaluations that allow analysts to capture broad impacts, but their application requires tailored methodologies and a structured approach to ensure accuracy and consistency.

### 1.3 Aim

This guidance report provides a multidimensional performance measurement toolset for SCI. It aims to integrate cross-sectoral evaluation techniques, define standardized criteria, and offer actionable guidance to policymakers, practitioners, and analysts involved in implementing and evaluating SCI models. The ultimate goal is to ensure informed decision-making that maximizes societal value and resource efficiency.

## 2 Methods used to develop the guidance

### 2.1 Selection of cross-sectoral evaluation framework

Since the traditional CEA and CUA fail to capture multiple outcomes beyond health, a conceptual comparison of existing evaluation frameworks was conducted to identify their strengths, limitations, and applicability to evaluate SCI. In that comparison, cost-consequence analysis (CCA), which provides a comprehensive summary of the different costs and outcomes, is excluded because it does not provide a single metric of value-for-money creating therefore room for selectively highlighting of positive outcomes[1].

The following cross-sectoral evaluation frameworks have been considered in the debvelopment of the guidance provided in this deliverable:

- Programme Budget Marginal Analysis (PBMA), focuses on allocating resources effectively within constrained budgets. PBMA involves identifying areas where resources can be reallocated to achieve greater overall value, often by targeting interventions with the highest marginal benefit relative to their cost. This method is particularly useful in cross-sectoral contexts where competing priorities and limited budgets require careful consideration.
- Cost-Benefit Analysis (CBA) is a widely used method that compares the total costs of an intervention to its benefits, expressed in monetary terms. CBA helps decision-makers determine whether the benefits of an intervention outweigh its costs, providing a clear return-on-investment perspective. For example, CBA has been applied to preventive health programs to quantify reductions in healthcare costs, improved workforce productivity, and societal benefits such as reduced criminal justice involvement.
- Social Return on Investment (SROI) assigns monetary values to diverse outcomes, such as improved quality of life and reduced social care costs, enabling a ratio-based assessment of investment value. It’s ideal for holistic evaluations but may require extensive data.

[1] Drummond and colleagues, in their widely cited work, "Methods for the Economic Evaluation of Health Care Programmes," define CCA as a form of partial economic evaluation as it does not aggregate or combine costs and consequences into a single metric (3).

- Multi-Criteria Decision Analysis (MCDA), on the other hand, allows decision-makers to weigh criteria such as health outcomes, economic savings, and patient satisfaction, tailoring the evaluation to local priorities. For instance, MCDA was used in the SELFIE project to prioritize interventions based on stakeholder-defined criteria.

An overview of the cross-sectoral evaluation frameworks alongside their pros and cons in for evaluating SCI is presented in Table 1.

Table 1. Comparison of cross-sectoral evaluation frameworks

| Framework | Pros | Cons | Best suited for evaluating SCI |
|---|---|---|---|
| **Cost-Benefit Analysis (CBA)** | Provides clear monetary return-on-investment perspective. Simplifies comparisons across interventions. | May oversimplify outcomes by focusing solely on monetary values. Ignores qualitative aspects. | Interventions with easily monetizable outcomes. |
| **Programme Budget Marginal Analysis (PBMA)** | Ensures efficient resource allocation within constrained budgets. | Requires detailed data on costs and marginal benefits. Can be complex to implement. | Resource prioritization within limited budgets. |
| **Social Return on Investment (SROI)** | Captures diverse social, economic, and environmental impacts. Provides a ratio-based value assessment. | High data requirements. Subjectivity in assigning monetary values to qualitative outcomes. | Holistic evaluations emphasizing social value. |
| **Multi-Criteria Decision Analysis (MCDA)** | Accounts for multiple criteria and stakeholder priorities. Flexible and adaptable to local contexts. | May be resource-intensive. Weighting criteria can be subjective. | Complex interventions with diverse outcomes. |

The table shows that although PBMA may involve evaluating the additional benefits and costs of incremental changes in program funding, the analysis often relies on subjective judgments. Furthermore, whilst CBA and SROI offer valuable insights into financial and societal impacts, they lack the flexibility to address the multidimensional nature of SCI. It would also be very challenging to monetise all outcomes of interest (e.g., patient experience), and even if possible, it could potentially be costly and time-consuming. MCDA emerges as the most suitable framework for evaluating SCI due to its ability to incorporate diverse outcomes across multiple sectors and reflect stakeholder priorities effectively. Its flexibility allows for a tailored approach, critical for the nuanced and multi-dimensional nature of SCI evaluations.

A guidance based on MCDA to evaluate SCI could potentially support stakeholders (to be) engaged in SCI by combining economic evidence with public values. MCDA is a systematic and theory-based approach designed to perform a comparative analysis of several competing investment options based on their performance on multiple criteria. It stands out as an approach that allows for a systematic and impartial evaluation of health interventions, including SCI, bridging the gaps that characterise traditional health economics methods. Beyond measuring health impacts, MCDA enables the inclusion of additional decision-maker interests, such as equity and patient experience, and has been used in several sectors outside health such as transport and environment. Furthermore, its versatility allows for the explicit consideration of public preferences for multiple

outcomes by assigning weights to each outcome of interest. This is particularly valuable as incorporating public preferences in the decision-making process enhances the legitimacy and accountability of SCI partners. MCDA synthesizes the performance of interventions across multiple criteria into a single, comprehensive measure of effectiveness, allowing local decision-makers to develop a systematic ranking of various SCI initiatives.

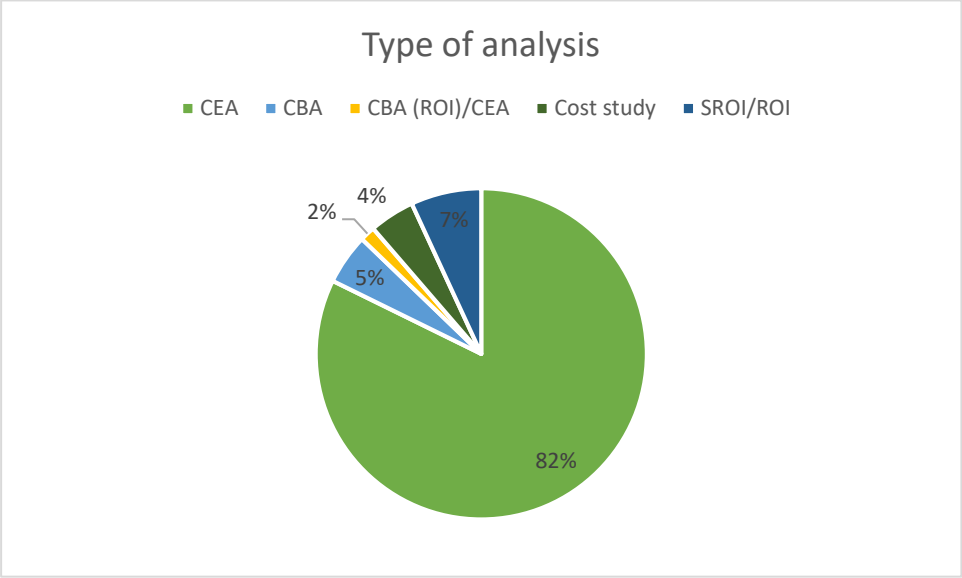
## 2.2 Scoping review of empirical cross-sectoral evaluations

The guidance also draws on an extensive scoping review of empirical evaluations of healthcare interventions that incorporated outcomes and costs in sectors beyond the healthcare sector and provides an overview of underlying evaluation frameworks and their operationalisation. The review identified 204 unique publications from which information regarding evaluation frameworks employed, sectors evaluated, how outcomes were measured and monetised, how resource use in different sectors was valued and monetised, and what methods were employed to measure outcomes and costs. Identified cross-sectoral evaluations primarily concerned curative healthcare interventions, rather than disease preventing/health promoting interventions.

However, the multi-sectoral nature of the evaluations builds upon and is complementary to the scoping review of SCI examples (T2.1). The scoping review of SCI examples compiled outcomes across health and well-being and non-health outcomes utilised in their evaluations (see Annex 6).

Figure 1 provides the frequency of the different types of analysis for cross-sectoral evaluation identified in the scoping review. The most common type of analysis used was CEA taking the societal perspective (82%), followed by SROI (7%), cost analysis (4%) and CBA (5%). The lack of identifying cross-sectoral evaluations using MCDA shows that this type of analysis has been used to capture outcomes within healthcare (see Gongora 2024). Despite that finding, MCDA was still considered as the most suitable framework for evaluating SCI for reasons explained in the previous section.

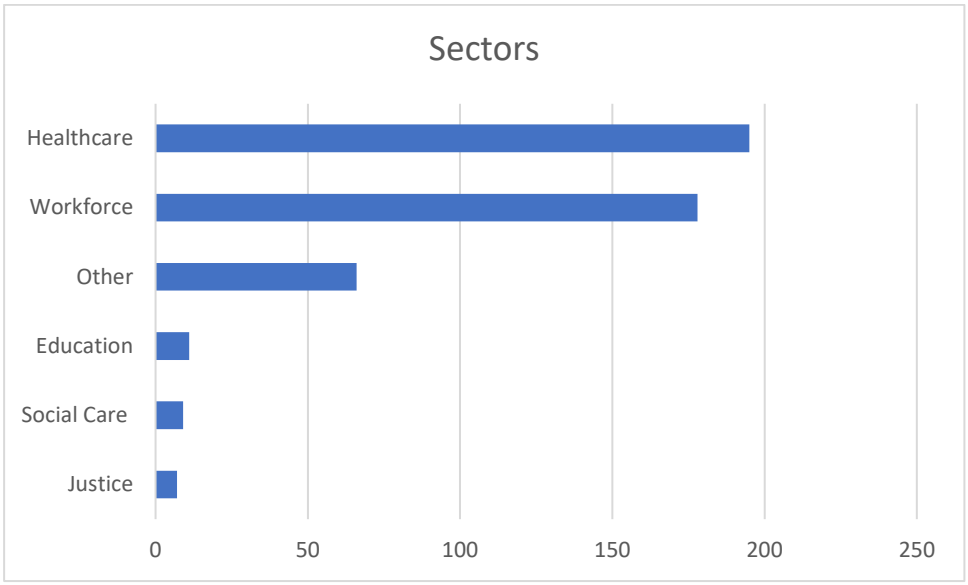
Figure 1. Evaluative framework methods and frequency of use in cross-sectoral evaluations




The most common additional sector was workforce, using different methods to measure and monetise productivity. Other additional sectors were transport, social care, education, justice and

environment. A breakdown of lead sectors involved in both SCI examples (T2.1) and cross-sectoral evaluations of healthcare interventions (T4.3) is available in Annex 3.

Figure 2. Sectors covered in the included studies




## 2.3 Stakeholder Engagement

Regular structured meetings (e.g. Deep dives and meetings dedicated to the cross-sectoral evaluation) and round tables (during in person I4H project meetings) with representatives of the 4 test-beds in I4H were conducted to assess the suitability of MCDA in the evaluation of SCI and identify key evaluation priorities.

# 3 Guidance for cross-sectoral evaluation

The guidance for cross-sectoral evaluation provides a step-by-step methodology to ensure that complex, multidimensional SCI interventions are evaluated comprehensively. This section incorporates the foundational principles of Multi-Criteria Decision Analysis (MCDA), emphasizing its adaptability and suitability for evaluating SCI. By addressing the decision context, stakeholder involvement, criteria selection, and analysis techniques, this guidance enables investors involved in SCI to demonstrate value-for-money while ensuring alignment with set priorities (societal or other).

## 3.1 Analysis of decision context

The decision context in cross-sectoral evaluations is complex, involving multiple stakeholders, sectors, and priorities. Understanding this context requires a systematic approach to identify all relevant players and investment options. Analysing the decision context ensures alignment between evaluation methods, intervention goals, and the values of the affected populations.

### 3.1.1 Stakeholders and other key players

Effective SCI evaluation requires engaging stakeholders from diverse sectors to capture the full scope of potential impacts. Key stakeholders include healthcare providers, social care agencies, local authorities, education systems, and non-governmental organizations. Additionally, patients, informal caregivers, and community representatives play a critical role in shaping evaluation

priorities by providing insights into lived experiences and unmet needs. Such a multi-stakeholder framework ensures that evaluations incorporate perspectives from all relevant groups. For instance, healthcare professionals may prioritize clinical outcomes, while policymakers focus on cost-effectiveness and scalability. Caregivers and patients, on the other hand, often emphasize quality of life and accessibility.

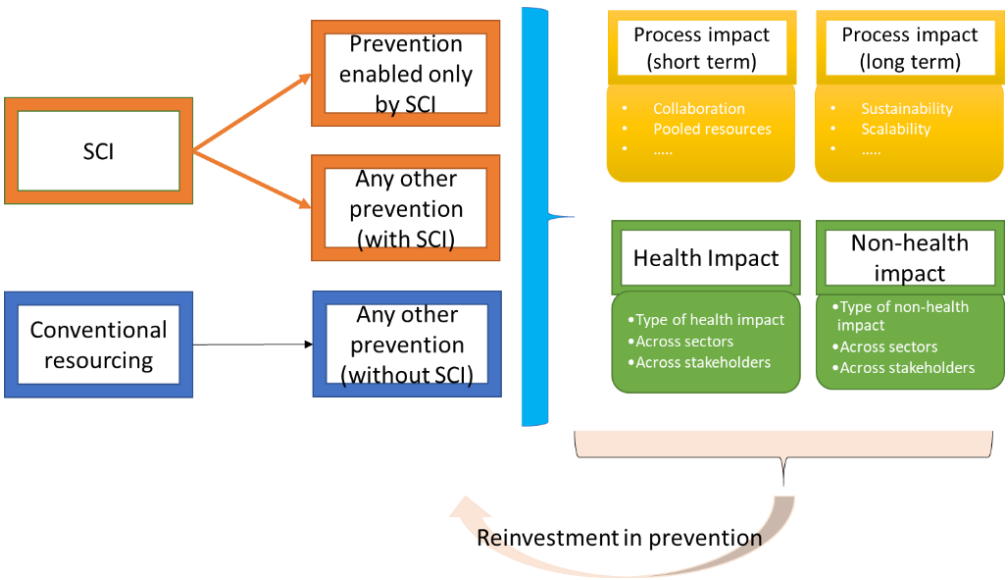
Stakeholder engagement also fosters transparency and accountability. Facilitated workshops and focus groups can help stakeholders articulate their priorities and concerns, enabling evaluators to develop a shared understanding of the intervention's objectives. Early and sustained engagement ensures that evaluations remain relevant and aligned with societal values.

### 3.1.2 Investment alternatives

Identifying and evaluating investment alternatives is a cornerstone of the decision-making process in SCI models. These alternatives typically include both business-as-usual scenarios and innovative investment alternatives aimed at promoting health promotion and disease prevention across sectors. For example, investment options may range from maintaining existing healthcare services to implementing new community-based care initiatives.

It is important to stress that the primary aim of an SCI evaluation is to compare different types of resourcing of preventative interventions, rather than a direct comparison of the preventative interventions. This is illustrated in Figure 3 where there are three potential groups of alternatives to be compared in the cross-sectoral evaluation of SCI: a) SCI resourcing a prevention intervention that would be be provided otherwise, b) SCI resourcing a prevention intervention that would be resourced with conventional resourcing, and c) conventional resourcing of a prevention intervention.

Figure 3. Illustration of investment alternatives in SCI evaluation




The process of evaluating alternatives involves assessing their potential impacts on health and non-health outcomes across sectors and stakeholders as well as process outcome in the short term (e.g. commaboration amd pooled resources) and long term (sustainability of resourcing and scalability).

The idea is that the impact of SCI on these types of outcomes would free up resources in order to be invested in prevention, creating therefore, the ”legacy effect” of SCI. This legacy effect will drive SCI to become business as usual in the long term as it would keep the stakeholders incentivised to keep resourcing health prevention. MCDA is particularly well-suited for this task, as they allow for the integration of diverse criteria and stakeholder priorities. For instance, an MCDA analysis of a preventive mental health program might weigh the cost savings from reduced hospital admissions against the societal benefits of improved educational outcomes and workforce participation. In the context of SCI, investment alternatives often involve balancing short-term costs with long-term benefits. Policymakers must consider factors such as scalability, equity, and sustainability when comparing options. Tools such as scenario analysis and sensitivity testing can help decision-makers understand the trade-offs associated with different investment paths.

As part of the guidance, we developed a template to get information about the resourcing mechanism (i.e. SCI vs conventional), the underlying prevention intervention (i.e. the intervention subject to the investment), and the involved stakeholders that commmit resources to the underlying intervention. An example fo the template completed with information from the I4H test bed in Wales in presented in Table 2.

Table 2. Example of using the I4H-resource mapping template in the Welsh test-bed

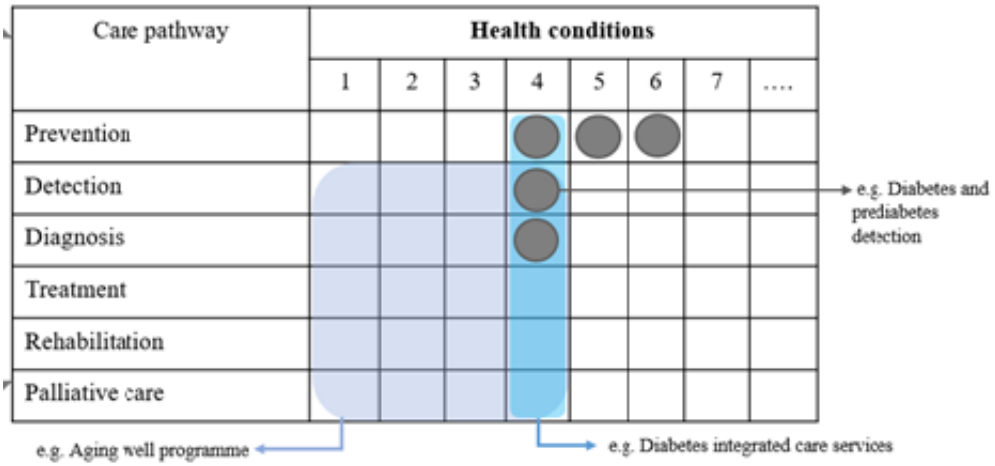
| | INTERVENTION<br>*Describe the interventions of interest and their individual components below.* | | Carmarthenshire | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Service user | | HDUHB | | Local Authority | | Other (e.g. community group, sports club, charity, business) | |
| A | **Digital platform** | **Implementation date in Camartheshire** *(if not implemented put NA)* | Type of resource/ contribution | Value of resource/ contribution (£) | Type of resource/ contribution | Value of resource/ contribution (£) | Type of resource/ contribution | Value of resource/ contribution (£) | Type of resource/ contribution | Value of resource/ contribution (£) |
| 1 | Wide range of live-streamed physical activity classes, including specialist sessions (e.g. for cancer/MSK/pregnancy, children's physical ) available to stream at home and/or in community hubs. | | Session fee OR Service subscription fee | £2.50 per in person session OR £10 per month | No contribution | £0 | Development Cost | £2-3000 plus time of the development team. | No contribution | £0 |
| | Wide range of pre-recorded, on-demand physical activity classes available to stream at home and/or in community hubs. | | | | | | General management/ maintence costs? | £300/month + £1 for every person who accesses / month | | |
| 2 | NERS/Falls prescribed live-streamed sessions available to stream at home and/or in community hubs. | | | | | | Adding new programmes/ sessions to platform? | | | |
| B | **Community hubs** | **Implementation date in Camartheshire** *(if not implemented put NA)* | | | Type of resource/ contribution | Value of resource/ contribution (£) | Type of resource/ contribution | Value of resource/ contribution (£) | Type of resource/ contribution | Value of resource/ contribution (£) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Physical space for live, in-person sessions. | End of August 2024 | | | | Venue hire | Overall funding of £400k (to get community hubs online). | | |
| 2 | Physical space for live-streaming sessions available on digital platform. | | | | | Staff costs | | | |
| 3 | Physical space for streaming pre-recorded, on-demand sessions available on digital platform. | | | | | Electronic equipment for streaming sessions available on digital platform. | | | |
| 4 | Physical space for social prescribing/ NERS consultations etc? | | | | | Physical exercise equipment | | | |
| | | | | | | Specialist session equipment | | | |
| | | | | | | Tables and chairs | | | |
| **D** | **Diabetes prevention programme** | **Implementation date in Camartheshire** *(if not implemented put NA)* | | Type of resource/ contribution | Value of resource/ contribution (£) | Type of resource/ contribution | Value of resource/ contribution (£) | Type of resource/ contribution | Value of resource/ contribution (£) |
| 1 | Patient 1:1 Brief Intervention | Jan-23 | | HB Staff | £18 per patient | | | | |
| 2 | Foodwise for Life 8 week course | Jan-23 | | HB Staff | £144 per patient | Funding to cover intervention costs - staffing, equipment, room hire, training, etc | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | NERS Physical Activity Sessions | | Jan-23 | | | £17k direct funding | 1.5 Full time exercise instructors/ NERS Staff - HB Funded. Room hire/training/ equipment | | | |
| 4 | Patient 6 month review | | Jul-23 | | HB Staff | £18 per patient | | | | |
| 5 | Patient 12 month review | | Jan-24 | | HB Staff | £18 per patient | | | | |
| **E** | **Social prescribing** | | **Implementation date in Camartheshire** *(if not implemented put NA)* | | Type of resource/ contribution | Value of resource/ contribution (£) | Type of resource/ contribution | Value of resource/ contribution (£) | Type of resource/ contribution | Value of resource/ contribution (£) |
| 1 | **Carmarthenshire County Council Social Prescribers** SP's based in surgeries and meet regularly with Actif Sport & Leisure to update knowledge on services in readiness for signposting those on GP lists | | | | Whole service funded by health board. 6 Full time staff in Carms, band 4. | £102, 096 - £112,040 depending on increment. | SLA with the local authority. 5 staff employed by LA, HB pays local authority. | | | |

As the underlying health (prevention) intervention that receives the investment is the main driver of the value-for-money of SCI, thorough categorization and explanation of its different components and their interaction is needed to understand the mechanisms of SCI value creation. Figure 4, provides a matrix to help SCI evaluators thinking about the health investment targeted with SCI.

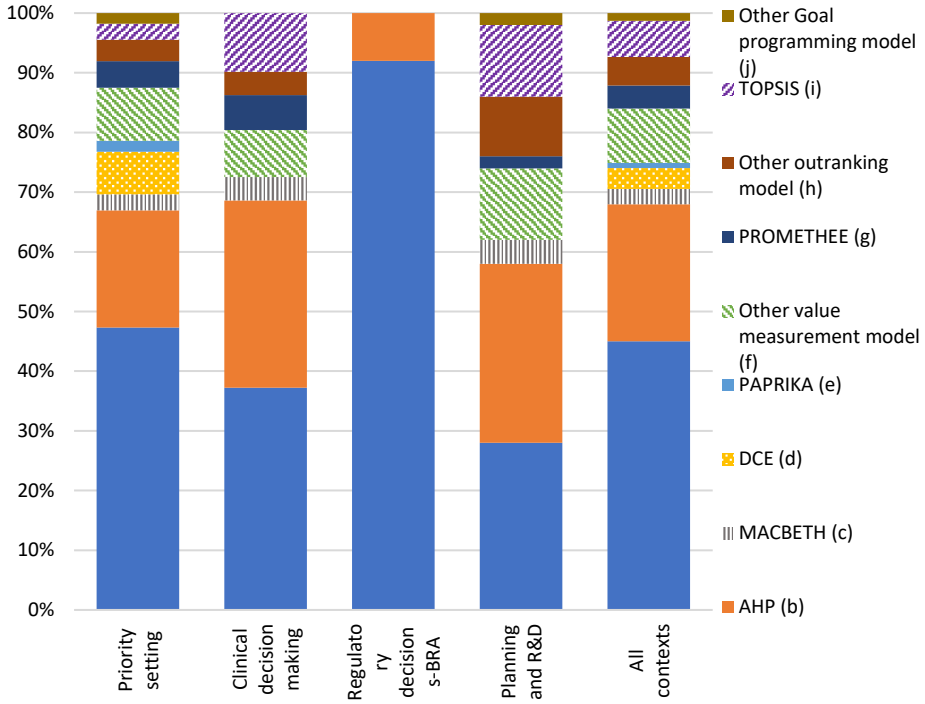
Figure 4. The alternatives: Type of healthcare interventions to commission




## 3.2 Selection of MCDA technique

The selection of the most appropriate MCDA technique is critical for ensuring that evaluations of SCI effectively address the multidimensional and complex nature of these interventions. A recent review study of MCDA evaluations of health interventions showed that the vast majority of studies have adopted a value-measured approach (86%, n=189), with linear additive models (e.g. multi-attribute value theory (MAVT), weighted sum) and analytic hierarchy process (AHP) as the most common approaches adopted (Figure 5).

Figure 5. MCDA methods across different decision-contexts




Notes: Value measurement models include: (a) Multi-attribute utility theory (MAUT), multi-attribute value theory (MAVT), weighted sum, and Simple Multi-Attribute Rating Technique methods (192). (b) AHP: Analytic hierarchy process (193); (c). MACBETH: Measuring attractiveness through a categorical-based evaluation technique (196); (d) DCE: Discrete choice experiment (197); (e) PAPRIKA: Potentially all pairwise rankings of all possible alternatives (198) and (f) other value-measurement models (e.g. Socio-Technical Allocation of Resources). Outranking models include: (g) PROMETHEE: Preference ranking organization method for enrichment evaluations (194); (h) other outranking models (e.g. Elimination and choice expressing the reality). Goal programming models include: (i) TOPSIS: Technique for order preference by similarity to ideal solution (195); and (j) other goal programming models (e.g. VIKOR). (k) Direct rating includes scales and point allocation techniques.

The choice of MCDA method depends on the context of the intervention, the availability of data, and the priorities of stakeholders. Several widely used MCDA techniques are particularly suitable for SCI evaluations:

Multi-Attribute Utility Theory (MAUT): MAUT is a comprehensive method that evaluates alternatives by assigning utility values to each outcome. These utilities are aggregated using weights that reflect the relative importance of criteria. As MAUT is better suited for quantitative evaluations, it is well-suited for SCI evaluations where quantitative data is available for outcomes like health improvements, cost savings, and societal benefits.

Analytic Hierarchy Process (AHP): AHP is a structured technique for organizing and analyzing complex decisions. It involves decomposing a decision problem into a hierarchy of sub-problems, comparing them pairwise, and assigning weights to criteria based on stakeholder input. AHP is particularly useful in SCI evaluations for integrating diverse stakeholder preferences, such as balancing cost savings with improvements in patient quality of life.

Simple Multi-Attribute Rating Technique (SMART): SMART is another straightforward MCDA method that uses a linear additive model to score alternatives based on weighted criteria. It allows

stakeholders to assign scores and weights to each criterion, enabling a clear and transparent comparison of options. This technique is particularly useful when stakeholder input is essential but data availability is limited or qualitative.

ELECTRE (Elimination and Choice Expressing Reality): ELECTRE is a family of outranking methods that assess alternatives based on a set of criteria, identifying those that outrank others without requiring complete aggregation of criteria. ELECTRE is particularly effective for addressing conflicts between criteria, such as equity versus efficiency.

PROMETHEE (Preference Ranking Organization METHod for Enrichment Evaluations): PROMETHEE uses pairwise comparisons of alternatives to rank them based on stakeholder-defined preferences. It is particularly valuable in SCI contexts where qualitative criteria, such as stakeholder satisfaction or community engagement, are important.

The following factors guide the selection of an appropriate MCDA technique for SCI evaluations:

- Stakeholder Priorities: Techniques like AHP and PROMETHEE are particularly effective in capturing and integrating stakeholder preferences.
- Data Availability: MAUT require quantitative data for all criteria, whereas SMART, ELECTRE and PROMETHEE can accommodate qualitative assessments.
- Complexity of the Decision Problem: For highly complex evaluations involving conflicting criteria, ELECTRE or PROMETHEE may be more appropriate than simpler methods like AHP.
- Transparency and Usability: Methods that facilitate clear communication of results, such as AHP, are advantageous for engaging non-technical stakeholders in the decision-making process.

The selected MCDA technique should be flexible enough to adapt to the specific needs of the evaluation while ensuring methodological rigor and stakeholder engagement. By leveraging the strengths of the chosen method, decision-makers can ensure that SCI evaluations are robust, transparent, and aligned with societal values. Table 3 provides a detailed comparison of these MCDA techniques highlighting their pros and cons for SCI evaluations.

Table 3. Overview and comparison of most popular MCDA techniques

| MCDA Technique | Description | Pros | Cons | Best suited for SCI |
|---|---|---|---|---|
| **Multi-Attribute Utility Theory (MAUT)** | Assigns utility values to outcomes and aggregates them based on weights. | - Handles quantitative data comprehensively- Allows detailed sensitivity analysis | - Requires precise quantitative data- Implementation complexity | Data-rich SCI contexts with detailed criteria evaluations. |
| **Analytic Hierarchy Process (AHP)** | Hierarchical decomposition of decision problems, with pairwise comparisons and weighting. | - Integrates diverse stakeholder preferences- Clear and systematic structure | - Pairwise comparisons can become complex for large problems- Subjective weighting | Situations needing a balance between cost and quality outcomes. |
| **Simple Multi-Attribute Rating Technique (SMART)** | Assigns scores and weights to alternatives based on a linear additive model. | - Easy to apply with stakeholder input- Clear and transparent for qualitative data | - Limited depth in handling complex trade-offs | Qualitative evaluations requiring high stakeholder engagement. |
| **ELECTRE** | Outranking method to identify alternatives that outperform others without aggregating criteria. | - Effective for addressing conflicting criteria- Handles qualitative and quantitative data | - Difficult to communicate results to non-technical stakeholders | Equity-focused decisions with conflicting criteria. |
| **PROMETHEE** | Ranks alternatives using pairwise comparisons based on stakeholder-defined preferences. | - Effective for qualitative criteria- Flexible to incorporate various types of stakeholder preferences | - Pairwise comparison method may become time-intensive | SCI evaluations emphasizing qualitative impacts. |

Based on the experience with the 4 test beds in I4h, it seems that a value-based Multi-Attribute Value Theory (MAVT) approach would be more appropriate/feasible for a SCI evaluation. This approach, grounded in decision theory[2], involves identifying, structuring and quantifying various attributes or criteria relevant to a decision-making context and then weighting these criteria based on their relative importance. MAVT is a simplification of Multi-Attribute Utility Theory (MAUT)[3]. While MAUT makes use of utility functions that account for decision-makers' attitudes toward risk, using the concept of lotteries, under MAVT a global value function is constructed for each alternative under evaluation to represent the global performance of the alternatives on the assessment criteria. This simplification makes MAVT more accessible and easier to implement in real-world scenarios. Although no MCDA model is without critics, models based on MAVT are the

[2] MAVT adheres to the fundamental axioms of value theory: transitivity and comparability (or completeness). Transitivity ensures that if option A is preferred to option B, and option B is preferred to option C, then option A is also preferred to option C. This helps maintain consistency in decision-making. Comparability, demands that, given any two options A and B, a decision-maker should be able to indicate which option is preferred or whether she or he is indifferent between the two options. It hence facilitates the direct comparison of different options based on their assigned values, enabling informed and rational choices. These axioms, integral to economic utility theory, provide the foundational logic for the existence of a real-valued function that can represent an individual's or a group's preferences (233).

[3] MAUT is an extension of the von Neumann-Morgenstern expected utility theory (211, 235). In their work, the authors established a set of fundamental axioms of rational choice, and then mathematically demonstrated that the only way a person could behave consistently with the full set of axioms is by choosing the option which possessed the maximum subjective expected utility value (ibid). Keeney and Raiffa's work in 1976 built upon the foundational concepts established by von Neumann and Morgenstern, by introducing a method to derive a single valuation index, U, to express the decision maker's overall valuation of an alternative (e.g., healthcare intervention) in terms of the value of its performance on multiple and often conflicting assessment criteria (i.e., multi-attribute utilities). With their work, the authors demonstrated that an additive model can be a straightforward approximation to the subjective expected utility model, preserving the axiomatic foundations of expected utility theory (161, 236).

most widely accepted, and its simplicity and structured approach makes it particularly pertinent for the evaluation of complex health interventions.

## 3.3 Definition of criteria (outcomes)

Definition of criteria is a critical step in evaluating SCI models using MCDA. Criteria represent the outcomes or dimensions that will be used to assess interventions. These criteria must capture the multi-sectoral impacts of SCI comprehensively, reflecting both direct and indirect effects. As illustrated in Figure 3, the impact of SCI could be on processes of care, health, and non-health outcomes.

### 3.3.1 Outcomes related to impact on processes

As explored through T2.1, various models of SCI can be classified within a typology based on several categories such as their scope (primary, secondary, or tertiary prevention); their partnership (investors, commissioners, service providers, beneficiaries, and outcome assessors) and their investment contract (type and size of investment, whether expected return is financial or non-financial). These various models of SCI each possess unique characteristics. This inherent heterogeneity can pose difficulty in assigning outcome measures evaluating the SCI mechanism. The SCI mechanism can be defined as the achievement of pre-determined goals set out by all stakeholders, over an appropriate and pre-determined time period.

Deliverable 2.3. of the I4H project has provided an indicative list of process outcomes to be considered in a SCI evaluation or just monitoring of SCI implementation.

Table 4. Indicative list of process outcomes for evaluating SCI

| Implementation features | Measured by |
|---|---|
| **Service Sustainability** | Financial sustainability (evergreen fund), organisational sustainability (staff retention) |
| **Governance** | Not yet defined |
| **Scalability** | Success of pilot study, evidence of scaling plan |
| **Business model** | Success of obtaining novel investment, interest in business model |
| **Impact measurement** | Health and well-being, social impact, typically part of an evaluation |
| **Motivation for investor** | Expected return to investor in contractual discussions: no returns, preferential return, non-preferential returns, non-financial investment, and other models |
| **Investment ecosystem** | Not yet defined |
| **Regulatory issues** | Political buy-in, health system architecture |

### 3.3.2 Outcomes related to impact on health

In developing our proposed outcome measures for evaluating the real-world impact of SCI, we considered the appropriate approaches to measurement. In I4H's Deliverable 2.3, a list of health outcomes was developed based on the scoping review of SCI examples in T2.1 and the scoping

review of cross-sectoral evaluations in T4.3. Table 5, presents an indicative list of outcomes that may be used to assess the impact of SCI on health. The most common outcome measures used to monitor the impact of the disease preventing/health promoting activity were general quality of life and well-being-related outcomes, behaviour-change-related outcomes (e.g., physical activity levels), process outcomes (e.g., number of participants, patient satisfaction) and multiple outcomes (mixture of health outcome and process measures) - mirroring the generic nature of the health and well-being goals targeted.

Of the outcomes evaluating the impact of the prevention activity itself identified in T2.1, most were measured through administering of a questionnaire to participants. The questionnaires completed differed by the outcome measure of interest. Interviews were used to measure a number of outcomes, in most cases in conjunction with some other form of measurement such as questionnaires or clinical assessments. Where multiple outcomes were grouped within an SCI example publication, these were often measured through surveys covering several outcome domains in one measure. Process outcomes (e.g., number of participants and patient satisfaction) were measured typically by routine data on contacts with the activity and wider healthcare resource contacts. Captured through published routine data or via questionnaire. Not all identified SCI examples were set within economic evaluations, so not all outcomes were valuated or monetised.

Based on the scoping review of cross-sectoral evaluations, the most common outcomes evaluating the impact of the health intervention identified in the review of multi-sectoral health evaluations of health interventions were the quality-adjusted life years (QALYs) or disability-adjusted life years (DALYs). QALYs and DALYs were typically measured through the EQ-5D questionnaire or estimated through lifetables and published utilities. QALYs and DALYs were monetised/valued through valuing collected health resource (or health resource use estimates from the literature) by unit costing or estimating and valuing productivity impacts from QALY/DALY utility values.

The second most commonly utilised outcome was well-being. Well-being encompassed pain, suffering, stress, happiness, confidence, life control, relationships, maintaining dignity, or sense of self. Well-being outcomes were commonly measured through questionnaires, such as the CORE-10, ÖMPSQ 10, PAM score, and ICECAP-A. Well-being measures were monetised/valuated in a similar way to QALYs/DALYs by valuing collected health resource (or health resource use estimates from the literature) by unit costing. One valuation of well-being measurement estimated pupil attainment from the literature as a result of improved well-being and monetised these through unit costing.

Improved physical and mental health formed two other areas of outcome measure identified by the review. For physical health the outcomes were measured typically by questionnaires such as the GAD-7, IPAQ-short, International Physical Activity Questionnaire Item, and PHQ-9. Physical health outcomes were valued through collected health resource use and monetised through unit costing. Improved mental health had significant overlap with well-being measures, using similar measurement tools as the ones listed above as well as domain-specific quality of life tools for mental health (a self-designed survey based on EQ-5D, GAD-7/General Anxiety Disorder-7, or SF-12. No description of how mental health outcomes were monetised or valued was identified in the literature.

Outcomes regarding hospitalisations, cases, disease and deaths averted were measure through published statistics and within the literature. Such outcomes were valuated through collected health resource (or health resource use estimates from the literature) and monetised by unit costing.

Of all costs identified, direct healthcare service use was the most common, appearing in 85% of included studies. The second most common cost that was measured was productivity found in 73% of all studies. Typically, this was measured by statistical data, including the Bureau of Labour Statistics, Census data, OECD labour force participation rate, or OECD average wage data. The descending frequency of other costs were transport (25%), social services (17%,), out-of-pocket expenses (13%), education (13%), housing (8%), medication (6%), economy and business (6%), justice (6%) and environment (4%).

Table 5. Indicative list of health-related outcomes

| Outcome | Measurement | Monetisation/ valuation |
|---|---|---|
| **Generic quality of life**<br><br>**[Quality Adjusted Life Years (QALYs)/Disability Adjusted Life Years (DALYs)]** | EuroQOL 5 dimensions (EQ-5D); General Anxiety Disorder-7 (GAD-7); Patient Health Questionnaire-9 (PHQ-9); Lifetable estimation; utility evaluation from the literature | Estimation using collected health resource use and valuation by unit costing; assumption of health resource use from literature; estimation of productivity impacts from data |
| **Health and well-being** | UCLA well-being scale; bespoke online well-being questionnaire; well-being self-assessment tool; Warwick-Edinburgh Mental Wellbeing Scale (WEMWEBS); Clinical Outcomes in Routine Evaluation-10 (CORE-10), Örebro Musculoskeletal Pain Screening Questionnaire ÖMPSQ 10), KINDL, Pediatric Quality of Life Inventory (PedSQL) and Satisfaction with Life Scale (SWLS), PAM score, and ICEpop CAPability measure for Adults (ICECAP-A). | Estimation using collected health resource use and valuation by unit costing; assumption and valuation of health resource use from literature; estimation of pupil attainment from the literature and costed by unit costing |
| **Improved mental health** | Self-designed survey based on EQ-5D, GAD-7, or Short Form Survey-12 (SF-12) | Not defined in literature |
| **Independence, resilience and social isolation** | TBS Resilience Outcomes Tool; semi structured interviews | Not defined in literature |
| **Behavior change** | Interviews; International Physical Activity Questionnaire (IPAQ) | Not defined in literature |
| **Increase in physical activity** | Accelerometers; logs of physical activity; International Physical Activity Questionnaire (IPAQ); GAD-7, IPAQ-short, PHQ-9 | Estimation using collected health resource use and unit costing |
| **Clinical outcomes (HbA1C, BMI)** | Clinical measurement; interviews; clinical tests | Not defined in literature |
| **Multiple outcomes (mixture of health outcome and process measures)** | Surveys across multiple dimensions | Not defined in literature |
| **Process Outcomes**<br><br>**(Averted hospitalisations, cases, disease, and death; participants perception of activity)** | Routine healthcare data on persons treated, appointments avoided; interviews; data on engagement with services; questionnaires | Estimation using collected health resource use and valuation by unit costing; assumption and valuation of health resource use from literature |

### 3.3.3 Outcomes related to non-health and non-process impact

Outcomes evaluating the healthcare activities in the review of multi-sectoral evaluations (T4.3) are presented below (Table 14). The table presents the various outcomes, the ways in which they were measured and their impact in terms of monetisation or valuation, following the framework of Drummond et al. (2015). More outcomes by sector are presented in Annex 1.

Table 5. Indicative list of outcomes to measure impact beyond the healthcare sector

| Outcome measure | Measurement | Monetisation/valuation |
|---|---|---|
| **Productivity (absenteeism, presenteeism, unpaid work and informal care)** | Statistical data, including the Bureau of Labour Statistics, Census data, OECD labour force participation rate | OECD average wage data |
| **Transport** | Utilisation of transport via questionnaire | Expert opinion, statistical data |
| **Social services (social service utilisation, care provision, counselling)** | Service utilisation data, routine data, NHS data, CORE counselling questionnaire, end of therapy questionnaire | Unit costing, assumptions based on published costs |
| **Out-of-pocket expenses (personal expenses** | Questionnaire | Estimation on questionnaire responses |
| **Education (therapy, special education, home education, tutoring, counselling, support to teachers/students, financing students)** | Questionnaire data, estimates from the literature | Estimation of costs through unit costs and prices of additional support |
| **Housing (living support, usual living situation)** | Questionnaire data | Not yet defined |
| **Economy and business (impact on local economy, cancelled events, tourism disruption)** | Not yet defined | Not yet defined |
| **Justice (reduction in crime)** | Crime statistics | Not yet defined |
| **Environment (water and sewage,** | Not yet defined | Not yet defined |

### 3.3.4 Selecting outcomes (criteria)

To select outcomes for inclusion in the SCI evaluation, a stepwise approach may be followed. First, the most relevant outcomes that are likely to be impacted by SCI need to be identified. In this step, logic models (as developed in I4H's WP3) may be used in combination with the lists of outcomes presented above. Second, candidate criteria may selected against theoretical properties of multi-composite value metrics founded in decision theory. These properties included:

(a) *Completeness*: To start, consider all potentially relevant criteria for SCI stakeholders;

(b) *Non-redundancy*: Focus on criteria that may be translated into outcome or impact metrics;

(c) *Non-overlap*: Criteria that may overlap with previously selected assessment criteria need to be excluded, aiming to avoid double counting; and

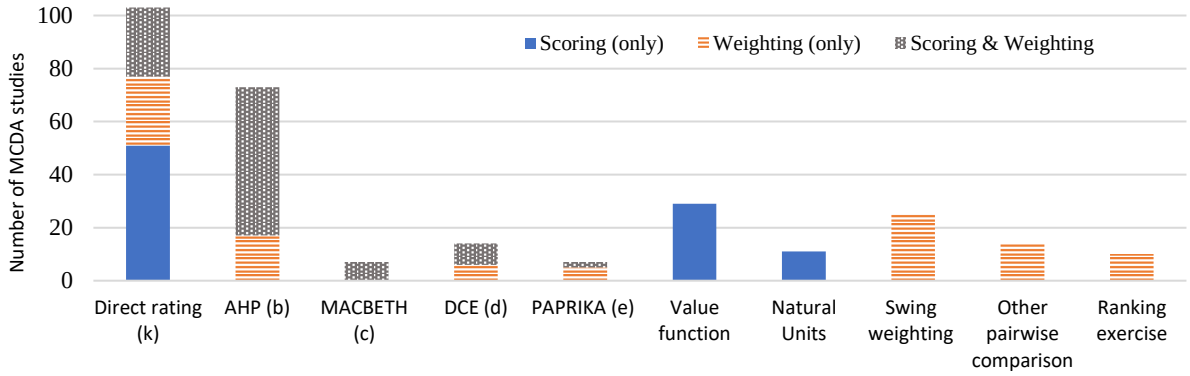
(d) *Operationality:* Assessment criteria that can be objectively assessed using data available to SCI evaluators.

## 3.4 Assignment of relative importance

Criteria weights aim to capture priorities or preferences of the public or other stakeholders for the different criteria. The weights represent “trade-offs” between criteria and are used to combine the scores on individual criterion into a measure of “total value”. To account for society preferences into the SCI evaluation, it is desirable that the relative weights of the assessment criteria identified reflect preferences from the public in the country of implementation. It is argued that members of the public should voice their opinions in the priority-setting process, in return for paying taxes. From a communitarian perspective, individuals are not only the recipients of rights, but members of a community with the duty to set the basis of the social choice rule. Making explicit societal preferences when setting priorities can also be justified based on democratic principles. Considering these ideas, which are also embedded in the underpinnings of CUA, prioritizing models of care that better satisfy societal preferences could arguably improve societal well-being and the legitimacy of the decision-making process in itself.

Figure 6 presents the most frequently used methods of obtaining weights in MCDA studies (please note that some of these methods can be used to obtain performance scores too). Even though discrete choice experiments (DCEs) have not been the most frequently used weighting method in MCDAs in healthcare, it may be preferred in cross-sectoral SCI evaluation because it is theoretically sound given its grounding in consumer theory, random utility theory and experimental design theory. DCEs are relatively easy to administer, do not require large samples, and participant’s voices are equally taken into account as responses are usually equally weighted in aggregation. The method has also shown to produce reasonable predictions of health-related behaviours. Between 2013 and 2017, at least 47 choice experiments were conducted to investigate trade-offs between health outcomes and patient or consumer experience factors, and 27 to develop priority setting frameworks.

Figure 6 Scoring and weighting methods




Notes: Value measurement models include: (a) Multi-attribute utility theory (MAUT), multi-attribute value theory (MAVT), weighted sum, and Simple Multi-Attribute Rating Technique methods (192). (b) AHP: Analytic hierarchy process (193); (c). MACBETH: Measuring attractiveness through a categorical-based evaluation technique (196); (d) DCE: Discrete choice experiment (197); (e) PAPRIKA: Potentially all pairwise rankings of all possible alternatives (198) and (f) other value-measurement models (e.g. Socio-Technical Allocation of Resources). Outranking models include: (g) PROMETHEE: Preference ranking organization method for enrichment evaluations (194); (h) other outranking models (e.g. Elimination and choice expressing the reality). Goal programming models include: (i) TOPSIS: Technique for order preference by similarity to ideal solution (195); and (j) other goal programming models (e.g. VIKOR). (k) Direct rating includes scales and point allocation techniques.

## 3.5 Performance scores

### 3.5.1 Assessment of performance

In case that a MCDA technique is chosen that provides performance scores (e.g. AHP and direct rating, see Figure 6), then the specific methodology of this technique has to be followed in order to assess the performance of each alternative on each criterion. However, if performance scores have to be estimated using real world evidence (e.g. using routinely or prospectively collected data set(s)) then an appropriate study design has to be specified accompanied with suitable statistical methodology to estimate the "impact" (or performance score) of each alternative on each criterion. For example, if MAVT has been chosen to evaluate SCI, the performance scores may be estimated using causal inference.

This section is based on the I4H's Deliverable 2.3 and the previous EU-funded ''Sustainable intEgrated care modeLs for multi-morbidity: delivery, FInancing and performancE" (SELFIE) project, (European Union's Horizon 2020 research and innovation programme, grant agreement number 634288). There is a range of study designs and statistical techniques suitable for assessing the causal impact of complex healthcare interventions, categorised into three groups: experimental designs, quasi-experimental designs that incorporate statistical techniques to improve comparability between intervention and counterfactual, and observational designs (Table 6). These groups vary by the extent to which causality can be inferred. We recognise that the 'gold standard' study design is often cited to be experimental randomised controlled trials (RCTs), which minimise bias and better enable investigation of causal inference (Webber & Prouse, 2018). RCTs are not always practical nor possible in real-world contexts, however, and quasi-experimental or observational studies may be more feasible. Inferring causation can be more difficult for these types of study design that offer less control over conditions and exposure, but there are methods for strengthening casual inference (Craig et al., 2017).

The full list and description of the study designs identified in D2.3 are available in Annex 1. For each testbed we proposed an appropriate study design based on current understanding of the SCI to be evaluated and associated data availability.

Table 6. Types of potential study designs for the evaluation of SCI

| Category | Study Designs/Approaches |
|---|---|
| Experimental designs | • RCT<br>• Cluster-RCT |
| Quasi-experimental designs and statistical techniques to improve comparability between intervention and counterfactual | • Stepped-Wedge Design<br>• Instrumental Variables<br>• Propensity Score Matching<br>• Regression Discontinuity<br>• Difference in Difference |
| Observational | • Natural experiments<br>• Case Control Study<br>• Interrupted Time Series Analysis<br>• Cohort Study |

The selection of study design may be driven by the available resources (e.g. budget, time, data, expertise and research capacity) and feasibility to design a prospective and/or experimental study. In I4H, this information about each testbed was captured through close collaborative working with testbed partners and WP6 colleagues responsible for conducting interactive and exploratory workshops with testbeds. Table 7 shows the relevant information that was used in designing a potential evaluation in each I4H test bed. Following the previous steps of this guidance, the underlying prevention intervention, SCI model, and relevant outcomes were specified. In addition, information about the specification of control groups, data availability and quality, need for ethical approval, and suitable statistical methods was gathered together with the test beds and used in the design of an evaluation study in each test bed.

Table 7 Information used in the design of potential evaluation in the I4H testbeds

| | | Wales | Skane | Galicia | Aachen |
|---|---|---|---|---|---|
| Method: A template to collect resources by stakeholder and intervention | Intervention | - Online platform<br>- Prediabetes prevention programme<br>- Social prescribing | - Early Coordinated Innovations (ECI) | - Home monitoring (online platform and wearables) for patients with cystic fibrosis | - To be defined |
| | SCI | - Local authority contributes in kind (e.g. space for social activities) and funds the online platform<br>- Health Board provides resources for the prediabetes programme and social prescribers; it also uses an innovation fund. | - Shared implementation resources between the region and municipalities (e.g. communications, process, data) | - The local NHS (SERGAS) provides the staff that monitor patients at home and may cover the expenses of the equipment for the home monitoring<br>- A CF charity provides training, care, knowledge, support to those with the home monitoring system | - To be defined |
| Method: A scoping review (4.3) and meetings with testbeds | Selected outcomes | Yes, diabetes risk factors | Yes, based on a logic model | A preliminary list is defined incl: staff time, patient convenience, health outcomes, access to care, informal care, productivity, school attendance for young patients | - To be defined |
| Method: meetings with testbeds and team's expertise | Study desing | Carmarthenshire vs the other 2 counties (controls) in the same health board | Municipalities at advanced stage of ECI (i.e. using shared resources) VS municipalities with | Patients with CF that use the home monitoring VS patient who do not. | - To be defined |
| | Data | Patient level data on diabetes risk factors of people in the prediabetes programme in the intervention and control counties. | National dashboard with monthly data on (some) outcomes at municipal level (i.e. 33 municipalities in Skane) | Patient level data from the local NHS. However only ~30 patients are expected to have used the telemedicine by Dec 2024. | - To be defined |
| | Ethics | Nor required | Nor required | To be determined | - To be defined |
| | Analysis | - Causal inference on risk factors using PSM<br>- CEA using the UKPDSv2 | Interrupted time series with control group | - Causal inference using PSM | - To be defined |

### 3.5.2 Standardization of performance scores

Ensuring consistency and comparability in evaluating Smart Capacitating Investment (SCI) interventions requires the standardization of performance scores. Standardized scoring enables decision-makers to assess different investments in health promotion and disease prevention using

a common framework, ensuring that evaluations remain objective, transparent, and aligned with broader policy objectives. A standardized performance scoring system involves defining clear benchmarks and thresholds for each evaluation criterion. This system allows interventions to be rated consistently based on their effectiveness, equity, feasibility, and long-term impact. For example, health prevention programs targeting smoking cessation could be scored based on their reduction in smoking rates, cost savings to the healthcare system, and improvement in overall life expectancy.

After estimating the performance of the alternatives on the different criteria, scores are obtained by converting performance indicators onto a common scale, considering the different units used for each criterion. To obtain scores on a 0 (no value) to 1 (maximum) value scale for all criteria, the relative standardization method could be used. It has been applied by several previous MCDA studies that have also used data to estimate alternatives' performance. Although most MCDA studies in healthcare have relied on direct rating methods (Figure 6) these methods can be prone to biases if decision-makers are influenced by recent experiences or other factors. Direct rating can struggle with different types of data, especially if they have very different scales or units. In addition, the use of categorical scales may result in a loss of information. Relative standardisation can take different types of data (ordinal, interval, ratio) and convert them to a common scale. The formula for relative standardisation is:

$$S_{a,k} = \frac{\mathrm{x}_{a,k}}{\left(x_{a,k}^2 + x_{\mathrm{b},k}^2\right)^{1/2}} \qquad S_{b,k} = \frac{\mathrm{x}_{\mathrm{b},k}}{\left(x_{a,k}^2 + x_{\mathrm{b},k}^2\right)^{1/2}}$$

$S_{a,k}$ ($S_{b,k}$) represents the standardisation of the performance score *x* of alternative *a* (*b*) on criterion *k* relative to the combined performance score of both alternatives, *a* and *b*, on criterion *k*. For outcomes where higher non-standardised score (i.e., on the natural scale) indicates a worse performance (e.g., lower costs are desirable), the scores $\mathrm{x}_{a,k}$ and $\mathrm{x}_{b,k}$ are replaced by $\frac{1}{X_{ak}}$ and $\frac{1}{X_{bk}}$, respectively. The resulted scores are called standardised performance scores.

Alternatively, the transformation of performance on the natural scale to a standardised score can be done using a local scaling approach, under which the best and the worst unstandardized performance scores of the alternatives are used as the upper and lower bounds of the value function. The formulae for local standardisation is $S_{a,k} = \frac{\mathrm{x}_{a,k} - \mathrm{x}_{min}}{\mathrm{x}_{max} - \mathrm{x}_{min}}$ , where $\mathrm{x}_{min}$ represents the minimum observed unstandardized performance score and $\mathrm{x}_{max}$ represents the maximum observed unstandardized performance score.

Another standardisation method includes the transformation to be done "globally", where the bounds are based on estimates of the worst and best possible outcomes, regardless of the alternatives' performance. For the decision-support framework that this thesis develops, the global approach is preferred over the local approach as it results more relevant when comparing performance of two interventions based on observed values, and it also makes it less sensitive to extreme values.

## 3.6 Calculating total scores and value-for-money

As indicated in section 3.2, Multi-Attribute Value Theory (MAVT) is identified as one of the most suitable MCDA techniques to evaluate SCI. Under MAVT, standardised performance scores are combined using the assessment criteria weights to derive a single value score for each alternative, allowing for a comprehensive comparison. Under the additive representation, which is the most common approach for evaluating alternatives, standardised performance scores ($S_{a,k}(x_{a,k})$) are weighted according to people's preferences ($w_k$)[4]:

$$V(X)_a = \sum_{k=1}^{m} w_k \, S_{a,k}(x_{a,k})$$

Where $V(X)_a$ represents the multi-attribute value function, or MCDA total score for alternative *a*, based on the performance of the alternative on m assessment criteria. Since the evaluation component of the framework is based on six assessment criteria, *m* equates to six in this formula.

There are two considerations when using this approach. First, when computing MCDA total scores using the MAVT-based additive model, mutual independence of preferences is a crucial concern. This means that the weight attached to one criterion should not depend on the performance on other criteria. Additional research is required to establish the most suitable course of action with regards to cases of preferential dependence. Some researchers would suggest restructuring the criteria set, assuring compliance with the preference independence principle, or adopting a different aggregation function. The former option could be problematic since relevant criteria may be excluded from the MCDA, violating the *completeness* criteria property. The second option would involve considering a multiplicative, multi-linear or Scale Loss Score (SLoS) model[5], but one needs to weigh the benefits of using these alternative models against their increased complexity. The main strength of the linear model is its intuitive interpretation[6], making it highly appealing to decision-makers. In light of this debate, the preference independence principle of the assessment criteria is statistically tested when estimating the criteria weights[7].

The second consideration concerns whether to include cost as a criterion in the MCDA, reflecting forgone value or opportunity cost. Advocates for including cost in the MCDA contend that reducing healthcare cost growth is a key objective of new care models, and consequently, cost is an integral part of the decision-making process. In addition, by including cost in the MCDA, its relative

[4] Additive functions are also frequently used in instruments designed to measure health-related quality of life, such as the EuroQol five-dimensions questionnaire.

[5] Under a multiplicative aggregation model the overall MCDA score for an alternative is determined by multiplying the standardised performance scores of each criterion rather than summing them, with each criterion's value being raised to the power of its respective weight before multiplication. The multi-linear model combines the linear and product model. These models are less commonly used in practice, as establishing their functional form and estimating the necessary parameters for these models is generally more complex compared to additive models. The SLoS model was developed by Saint-Hilary et al. to assess and compare the benefit-risk balance of treatments. The SLoS overall score of an alternative is based on the inverse of its performance scores across different criteria. For each criterion, the inverse of the performance score is taken, and this value is then raised to the power of its respective weight. These adjusted values are then summed across all criteria to obtain the overall SLoS-based MCDA score. A lower SLoS indicates a preferable alternative. While SLoS models may be more robust to the correlation in the criteria, their complexity may have contributed to their lack of widespread utilisation.

[6] A poor performance on criterion k can be compensated by a good performance on criterion j, and vice-versa.

[7] Arguably, the potential violation of the preference independence principle should have been formally considered during the criteria selection phase. However, this principle not only concerns the criteria themselves but also the preferences (relative weights) that stakeholders assign to them. Assessing preference independence entails understanding how preferences for one criterion are influenced by the performance of others, which can be challenging to comprehensively assess based on literature reviews.

contribution to the decision is made more explicit, and it is also possible to elicit people's willingness to pay for gains on other criteria. Conversely, some authors contend that although including costs in the MCDA makes the trade-offs explicit, cost is not a value element and MCDA's potential lies in reflecting a more comprehensive benefit measure. In that regard, it is crucial to establish the opportunity costs of each additional benefit unit, which cannot be achieved by incorporating cost into the MCDA. In a budget-constrained context, stakeholders' preferences are not the appropriate basis for evaluating the efficiency of health interventions and the benefits lost from not funding alternative options are more relevant than stakeholders' willingness to pay. Consequently, SCI stakeholders/investors need to assess whether the benefits of a new, costlier intervention justify its expense compared to the benefits that could have been produced by allocating resources elsewhere.

In principle, the resulted composite benefit score could be used to calculate a modified version of the incremental cost-effectiveness ratio. The ratio of the 'extra cost per extra unit of MCDA-based benefit' could be derived by dividing the incremental cost (i.e., the difference in total costs of the two alternatives being compared) by the difference in the MCDA-based benefit scores. However, for such evaluation the modified incremental cost-effectiveness ratio must be compared with a newly defined threshold, as the conventional threshold used in cost-effectiveness analysis does not encompass all elements of value. This threshold would not be unique, as the performance scores used to operationalize the criteria will potentially change depending on the nature of the medical condition or the interventions under assessment. Therefore, when the set of outcome measures changes, new thresholds must be determined. Additionally, the threshold may vary among SCIs due to their varying levels of economic development, which affects their ability to pay for health prevention interventions.

Alternatively, if the estimated performance of each alternative on each criterion would be possible to monetised (similar to a CBA), then the costs could be included in the Linear Additive Model and the MCDA total Score would be a Net Monetary Benefit metric (i.e. net of monetised benefits and costs) that incorporates the preference of the SCI stakeholders (or just public) for the different outcomes. However, it should eb noted that derived monetary value for all included outcomes could be a challenging, if possible, process for SCI evaluators.

## 3.7 Uncertainty analysis

After computing the MCDA total score for each alternative under assessment, it is important to consider the potential impact of uncertainty on the MCDA results. As highlighted in in good practice guidelines, MCDAs are susceptible to uncertainty and analysing and reporting it is essential for good practice.

In all economic evaluations, following Briggs et al typology, there are two forms of uncertainty: parameter and structural uncertainty[8]. The former refers to the variability in the estimation criteria

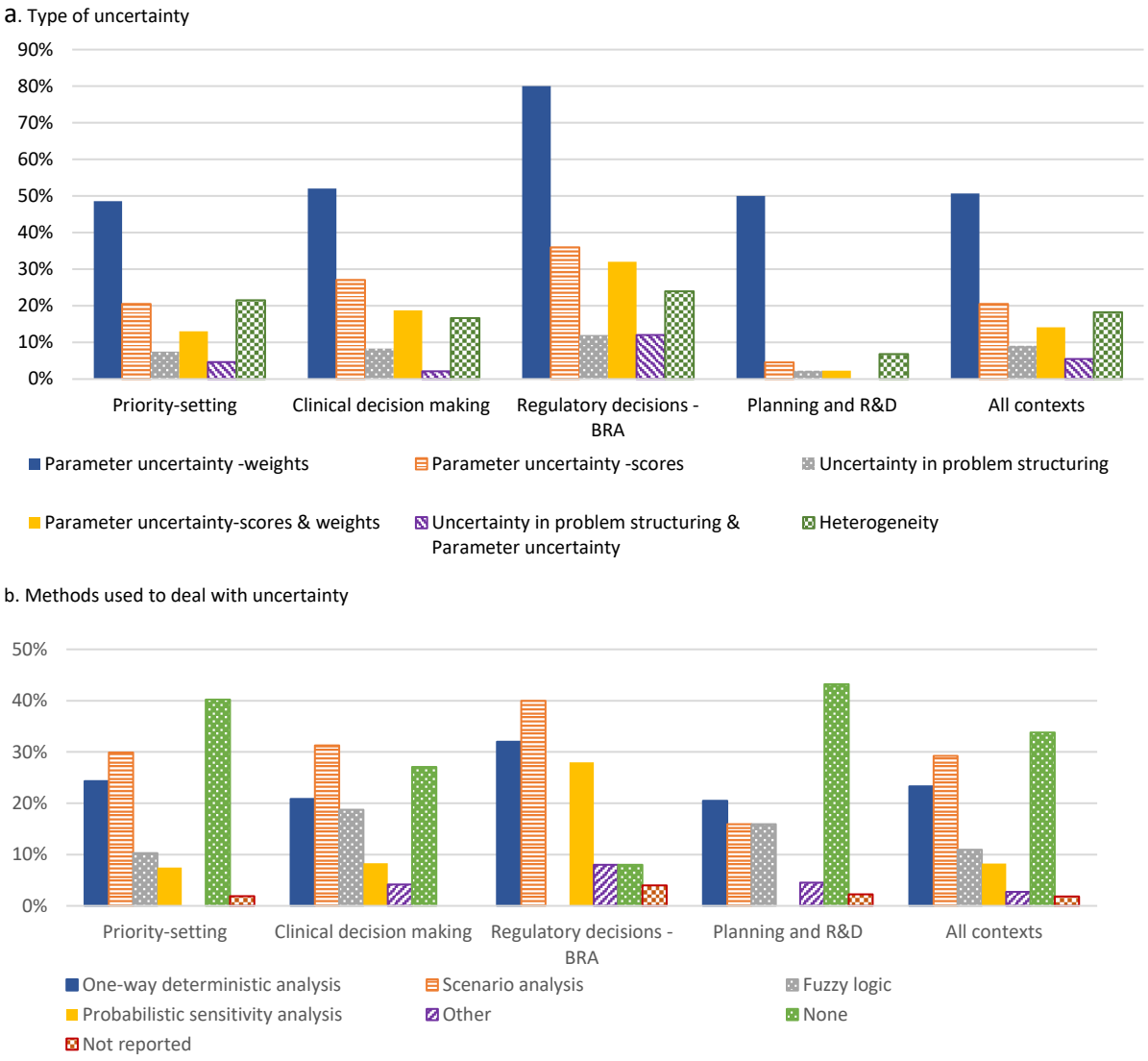
[8] Different authors have suggested multiple classifications of uncertainty. Broekhuizen et al, for instance, differentiates between stochastic uncertainty (random variability in outcomes between identical patients); parameter uncertainty (uncertainty in estimation of the parameter); heterogeneity (variability between patients that can be attributed to characteristics of those patients), and; structural uncertainty (assumptions inherent in the decision model) (188). Briggs et al. distinguish between variability (the differences that occur between patients by chance) and heterogeneity differences that occur between patients that can be explained) from decision uncertainty.

weights and performance scores as a result of the sampling (i.e. estimation error). The second, structural uncertainty, relates to the assumptions imposed in the decision model (e.g., aggregation model used, criteria included, selection of comparator).

To address parameter uncertainty, probabilistic sensitivity analyses (PSA) could be conducted using Monte-Carlo simulations with 1,000 replications. In case that criteria weights are estimated from empirical data (e.g. using DCEs), standard errors of the point estimates are used to represent the extent of the parameter uncertainty in weights. A similar approach could be adopted to address parameter uncertainty in performance scores when they are based on statistical inference (see section 3.5 Performance Assessment). The resulting MCDA scores distributions could be graphically summarised, together with the standard deviation and the corresponding 95% confidence intervals (CIs). In addition, to summarise the sensitivity of the results to uncertainty, the probability of preferring one of the SCI (*a*) over its comparator (*b*) is computed. This could be done by calculating the proportion of MCDA iterations in which the intervention *a* had a higher MCDA total score than intervention *b*. Furthermore, parameter uncertainty in the MCDA is graphically presented with the conditional multi-attribute acceptability curve (CMAC), proposed by Tsiachristas, Rutten-van Mölken and colleagues. The CMAC shows, across a variety of budget levels, the probability of a healthcare intervention being the most preferred option (i.e., having the highest MCDA score) while the budget impact remains below a budget-threshold. The CMAC extends the concept of acceptability curves, commonly used in CEA, to a multi-criteria context. The vertical axis of the CMAC displays the likelihood of a healthcare intervention being accepted as the most preferred alternative, whilst the horizontal axis shows varying thresholds of maximum budget for allocating to either of the interventions under evaluation to treat a given population size. The CMAC can support budget impact analysis as it visually demonstrates how the preference for healthcare interventions changes across a range of available budgets.

The impact of structural uncertainty could be explored by running the analysis using different weighting methods or different performance indicators. However, this can be costly and time-consuming, which partially explains why most MCDA studies in healthcare overlook structural uncertainty (Figure 7). The choice of criteria and their relationships is another source of structural uncertainty.

Figure 7. Type of uncertainty and methods used to deal with it across decision context




## 3.8 Presentation and deliberative process

The final step in the MCDA-based guidance for Smart Capacitating Investment (SCI) in health promotion and disease prevention is the presentation of the results and deliberation process. This stage ensures transparency, stakeholder engagement, and informed decision-making by systematically reviewing and interpreting the evaluation results.

To begin, the results must be communicated in a clear and structured manner. The performance of different interventions across various criteria should be compiled into a comprehensive report that is accessible to all stakeholders. This report should include both numerical scores and qualitative insights, helping decision-makers understand the trade-offs involved. Scorecards and rankings provide an organized way to compare interventions, while visualization tools such as charts, heat maps, and performance matrices help highlight the strengths and weaknesses of each option. Scenario analysis reports further contextualize the results by demonstrating how different investment decisions could impact health outcomes, costs, and equity over time. Additionally,

incorporating impact narratives helps ground the numbers in real-world implications, offering a more holistic perspective on the benefits and challenges of each intervention.

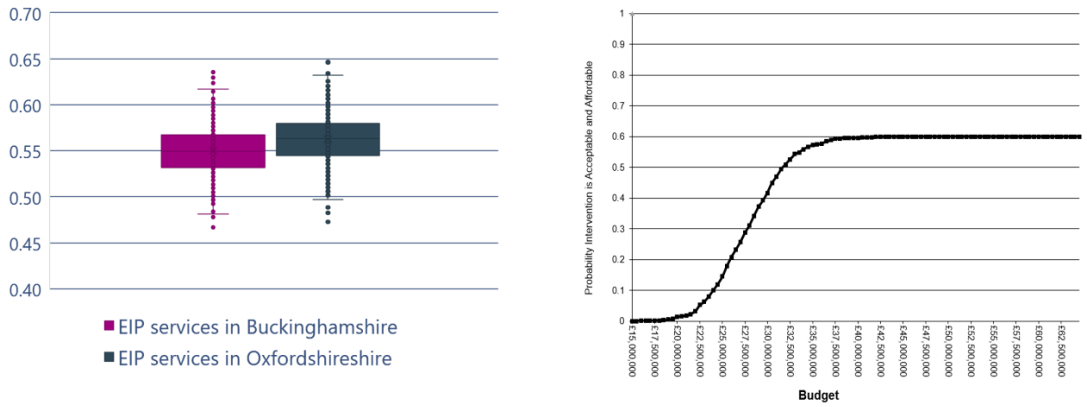
An example of presenting the results of an MCDA evaluation using MAVT is shown in Table 8. Two alternatives (in this case early intervention in psychosis services that incorporate healthcare and employment interventions to prevent psychosis relapse and keep patients longer in employment and outside hospitals) were compared against five criteria. The mean performance scores and relative weights and the surrounding uncertainty are presented separately before presenting the aggregated MCDA scores. The resulting cost-per-value ratios suggested that Oxf EIP (£ 10,572.4) provided more value per unit cost than Bucks EIP (£ 12,808.6). The results of a SCI evaluation could be presented similarly so that investors and other stakeholders could get a granular view of the value created on different value elements.

Table 8 Presentation of MCDA results and uncertainty (example)

| Assessment criteria | Operationalised assessment criteria | Standardized performance score (se) | | Relative weights (se) | | MCDA scores (with cost) | | MCDA scores (without cost) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Bucks EIP | Oxf EIP | with cost | without cost | Bucks EIP | Oxf EIP | Bucks EIP | Oxf EIP |
| **Final or intermediate health outcomes** | Years of life during observational period | 0.706 (0.004) | 0.708 (0.004) | 25.3% (0.019) | 25.3% (0.016) | 0.179 | 0.179 | 0.179 | 0.179 |
| **Quality of life and well-being considerations** | Average time-to-relapse across all relapses per patient | 0.756 (0.039) | 0.654 (0.045) | 12.1% (0.013) | 17.6% (0.014) | 0.091 | 0.079 | 0.133 | 0.115 |
| **Quality of care or features of the process of care delivery** | Disengagement with the service | 0.717 (0.067) | 0.697 (0.069) | 22.4% (0.020) | 25.2% (0.019) | 0.161 | 0.156 | 0.181 | 0.176 |
| **Equity** | Ratio of the average time-to-relapse between the most deprived deciles and the richest decile | 0.500 (0.150) | 0.866 (0.097) | 2.8% (0.021) | 9.6% (0.017) | 0.014 | 0.024 | 0.048 | 0.083 |
| **Cost or budget considerations*** | Annual average cost | 0.645 (0.029) | 0.764 (0.024) | 16.5% (0.013) | 0.013 | 0.106 | 0.126 | | |
| **Overall total score** | | | | | | **0.551** | **0.565** | **0.540** | **0.553** |

Similar to the example in Figure 8, the uncertainty in the MCDA mean scores and the CMAC could be graphically depicted in order to facilitate easier communication of the results to investors and other stakeholders.

Figure 8 MCDA total scores and conditional multi-attribute acceptability curve (CMAC)




Following the presentation of results, a structured deliberation process ensures that decisions are not made in isolation but through inclusive and participatory discussions. Facilitated workshops bring together policymakers, healthcare professionals, and community representatives to interpret the findings collectively. Expert panels consisting of specialists in health prevention, economics, and public policy provide further validation and insight into the implications of various choices. Public consultations play a crucial role in integrating the voices of affected communities, ensuring that social equity and public preferences are considered in the final decisions. Throughout this process, iterative decision-making allows for adjustments based on stakeholder feedback, ensuring that the final recommendations align with both scientific evidence and societal values.

Ultimately, the expected outcomes of this process are multifaceted. First, it ensures that resources are allocated efficiently to the most impactful interventions. Second, it fosters alignment between diverse stakeholders and builds a shared vision for investment in health promotion and disease prevention. Third, it enhances accountability and trust by making the evaluation process transparent and inclusive. Finally, the integration of MCDA-based results into national and regional health strategies supports long-term policy development, ensuring that SCI contributes to sustainable health improvements.

# 4 Discussion and next steps

The development of this guidance for Smart Capacitating Investment (SCI) in health promotion and disease prevention is a significant step towards improving decision-making processes across sectors. However, its application in real-world settings requires continuous refinement. The I4H team is committed to fine-tuning this guidance based on its application in test beds, ensuring that it remains relevant, adaptable, and responsive to evolving challenges in health promotion and disease prevention.

As the guidance is implemented, insights from test beds will be systematically collected and analysed to assess its effectiveness, usability, and impact on decision-making. This iterative learning process will help refine criteria selection, weighting mechanisms, and performance assessment methods to enhance accuracy and applicability. Lessons learned from different health systems, stakeholder feedback, and evolving public health priorities will be integrated to ensure the framework remains context appropriate and sensitive.

Additionally, the I4H team will focus on developing user-friendly materials to facilitate the adoption of this guidance. These materials will include step-by-step manuals, digital tools, case study examples, and training resources to support organizations in conducting SCI evaluations effectively. The goal is to make the methodology accessible to a wide range of stakeholders, including policymakers, healthcare professionals, community organizations, and researchers.

In the coming months, the refinement and dissemination of this guidance will be accompanied by training sessions, workshops, and capacity-building initiatives to ensure that stakeholders are well-equipped to apply MCDA principles in health promotion and disease prevention investments. Through these efforts, the I4H team aims to create a standardized yet flexible framework that can be adapted across different contexts, leading to more efficient and impactful SCI interventions.

Ultimately, Smart Capacitating Investment (SCI) represents a transformative approach to health promotion and disease prevention. By continuing to develop and refine this guidance, the I4H team is committed to supporting data-driven, inclusive, and effective decision-making processes that improve population health outcomes and create long-term societal benefits.

# 5 Challenges and limitations

While the Smart Capacitating Investment (SCI) framework for health promotion and disease prevention provides a structured, evidence-based approach to prioritizing investments, it is important to acknowledge several challenges/limitations that may affect its implementation and effectiveness in different contexts.

1. Data availability and quality: one of the primary challenges in applying the SCI evaluation guidance is the availability and reliability of data. Many SCI initiatives lack standardized data collection mechanisms, particularly in community-based or cross-sectoral settings. The accuracy and completeness of the evaluation depend on high-quality, longitudinal data, which may not always be accessible. Inconsistent reporting across different regions or institutions can also limit comparability and the robustness of assessments.
2. Complexity of the MCDA: The use of MCDA to evaluate SCI introduces a level of complexity that requires specialized expertise. Stakeholders may have different levels of familiarity with MCDA methodologies, leading to difficulties in interpreting results and assigning appropriate weights to criteria. While structured weighting techniques help standardize the process, subjective judgments and stakeholder biases can still influence decision-making, potentially leading to inconsistencies in evaluations.
3. Standardization and transferability challenges: The effectiveness of SCI evaluations depends on the ability to compare and standardize performance scores across different interventions and contexts. However, health prevention and promotion initiatives often vary significantly in scope, target populations, and implementation settings. While standardization efforts help improve comparability, there is a risk that rigid evaluation criteria may not fully capture the unique attributes of certain interventions, limiting the framework's adaptability.
4. Disentangling the impact of SCI from the impact of the underlying prevention intervention: a fundamental challenge in evaluating SCI interventions is separating the impact of the investment itself from the effects of the underlying health prevention intervention. SCI focuses on enhancing capacity, infrastructure, and implementation support, which may amplify or facilitate

the success of a prevention program but does not directly deliver the health outcomes. This interdependence makes it difficult to attribute observed improvements solely to SCI, requiring advanced evaluation techniques such as counterfactual analysis or long-term observational studies to isolate its contribution.

5. Incorporating evaluation into the value proposition for SCI negotiations: Performing a comprehensive SCI evaluation requires resources, expertise, and stakeholder buy-in, which can be challenging to secure, especially during early-stage negotiations for funding. Decision-makers may perceive evaluation as an additional cost rather than a necessary investment to demonstrate value-for-money. To address this, SCI assessments must be embedded into the broader value proposition, showing how robust evaluation enhances accountability, maximizes impact, and strengthens the case for continued or expanded investment. This will be demonstrated in I4H's Deliverable 4.2.

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# 7 ANNEX

## 7.1 Annex 1. Sectors and outcomes beyond the healthcare

Table A1.1. Breakdown of scoping reviews of SCI and cross-sectoral evaluations by lead sector.

| Lead Sector | Task 2.1 (Scoping review of SCI examples) (N=78) | Task 4.3 (Scoping review of cross-sectoral evaluations) (N=48) |
|---|---|---|
| **Health** | (n = 26, 34%) | (n = 39, 81%) |
| **Education** | (n = 5, 6%) | (n = 2, 4%) |
| **Employment/Workforce (including Occupational Health)** | (n = 10, 13%) | (n = 4, 8%) |
| **Social Care** | (n = 10, 13%) | (n = 2, 4%) |
| **For profit organisations Business** | - | (n = 1, 2%) |
| **Academia** | (n = 1, 1%) | - |
| **Environmental** | (n = 4, 5%) | - |
| **Not for profit (including responsible finance)** | (n = 6, 8%) | |
| **Housing** | (n = 5, 6%) | - |
| **Justice** | (n = 1, 1%) | |
| **Sports and recreation** | (n = 3, 4%) | - |
| **Social enterprise** | (n = 1, 1%) | - |

Table A1.2. Additional examples of outcomes and measurement indicator by sector

| Sector | Outcome | Indicator (example) |
|---|---|---|
| Arts, Heritage, Sports and Faith | Develops cultural skills and confidence in areas that interest them | Improved confidence in an area of interest |
| | Finds meaning and fulfilment from engaging with arts, heritage, sport and faith | Has access to a range of possibilities in the arts, heritage, sport and faith |
| | Public and corporate policy and expenditure that supports the arts, heritage, sport and faith | Improvements in policy and legislation |
| | Strong public awareness of and participation in the arts, heritage, sports and faith | Improved public awareness and engagement |
| | High quality, affordable, accessible and inclusive cultural services available to all | Improved availability of good quality affordable arts and cultural services for all |
| Conservation of the Natural Environment | Accesses and enjoys the natural environment and heritage | Proportion of population with access to a 2ha+ wood within 500m of where they live |
| | Conservation of natural spaces | Conservation of natural spaces, natural heritage and biodiversity |
| | Public and corporate policy and expenditure that supports the natural environment | Improvements in policy and legislation that is inclusive and retains principles of a just transition |
| | Recycling, waste and sustainable water use | Improvements in general waste and recycling |
| | Strong public awareness of and engagement with the natural environment, and good sectoral understanding as to how to sustain it | Improved public awareness |
| | Sustainable agriculture | Organic farming |
| | Sustainable buildings and transport | Construction and renovation of buildings with an environmental purpose |
| | Sustainable energy | Increased generation of renewable energy |
| | Understands the importance of and reduces the personal impact on the natural environment | Increased local sourcing |
| | Accesses and enjoys the natural environment and heritage | Improved access to and enjoyment of the natural environment (e.g. going for walks, visiting national parks etc.) |
| Employment, training and education | Is in suitable employment, education or training and has the on-going support to maintain it if necessary | Is in suitable education |
| | Has developed the necessary soft skills and attitude through employment, education or training (including social skills, attitude and motivation) | Improved attitude and motivation |
| | Has developed the necessary technical (hard) skills through employment, education or training (including literacy and numeracy, job search skills and job-specific qualifications) | Increased level of attainment |
| | Has found a way to address barriers to employment, education or training (including childcare, disability or benefits issues) | Would be financially better off in work than not |
| | Reduced barriers to employment, education or training | People participate in education, employment and training free from discrimination, abuse and other barriers |
| | Equitable access to high quality employment, training and education within a healthy local economy for all | Improved quality of education |
| | Strong corporate and institutional governance | Improved organisational, corporate and institutional governance |
| | Strong public awareness and participation in matters relating to education and employment, and good sectoral understanding of how to address them | Improved public awareness and engagement |
| | Public policy and expenditure that supports good quality employment, training and education | Improvements in policy and legislation |
| Housing and local facilities | Has a secure and suitable place to live in fit condition | Has secure accommodation |
| | Has the skills needed to manage and keep a place to live | Can maintain cleanliness and upkeep of home |

| | | |
|---|---|---|
| | Is motivated and able to live as independently as possible, and has the on-going support to maintain that if necessary | Improved feelings of confidence and motivation to live as independently as possible |
| | Has access to local shops, transport, facilities and recreation | Improved access to shops selling affordable necessary products and services |
| | Provision of adequate, affordable and safe accommodation | Everyone can live without fear of humiliation, harassment or abuse based on who they are |
| | Equitable access to sufficient accessible and affordable transport, utilities and local facilities for all | Improved availability of good, accessible and affordable public transport |
| | Strong public awareness and participation in matters relating to housing, and good sectoral understanding of how to address them | Improved public awareness and engagement |
| | Public and corporate policy and expenditure that supports good quality housing and local facilities | Improvements in policy and legislation |
| Income and financial inclusion | Has sufficient sustainable income, including benefits if appropriate | Achieved minimum level of income |
| | Has access to appropriate financial advice, products or services | Improved access to appropriate financial advice |
| | Is managing finances well | Improved financial literacy |
| | Equitable access to ethical responsible and suitable financial services and products available to all | Improved availability and design of fair financial products |
| | Strong public financial capability, literacy and management, and understanding of legal matters | Improved availability and use of financial support services |
| | Income equality | Improved income equality |
| | Strong public awareness and participation in matters relating to financial inclusion, and good sectoral understanding of how to achieve it | Improved public awareness and engagement |
| | Public and corporate policy and expenditure that supports fair income and financial inclusion | Improvements in policy and legislation |
| Physical health | Looks after physical health, maintains a healthy lifestyle and keeps safe | Eats and sleep well |
| | Enjoys good support and quality of life in relation to any longterm conditions | Addresses, understands and feels supported in managing any long-term condition |
| | Makes use of the health services to recover from episodes of ill-health or following injury | Uses health services and support when appropriate |
| | Has a positive experience of healthcare and attitude toward own physical health | Has a positive experience of healthcare |
| | Healthy and physically active people and communities | Healthy eating and appropriate levels of exercise |
| | Equitable access to good quality, safe health and social care services | Equitable access to health and social care services |
| | Strong public awareness and participation in matters relating to physical health, and advanced sectoral understanding of what makes for good health | Improved public awareness and engagement |
| | Public and corporate policy and expenditure that supports good physical health | Improvements in policy and legislation |
| Mental health and well-being | Has confidence, emotional balance and is resilient in the face of difficulties | Improved confidence and self-esteem |
| | Has a sense of purpose, engages in meaningful and fulfilling activity, and has aspirations for the future | Experiences overall satisfaction with life |
| | Has a positive experience of care and a good understanding of own mental health and emotional well-being | Is able to manage mental health problems |
| | Enjoys good support in relation to any mental health problems | Improved access to and increased use of support services |
| | Has a positive experience of care and a good understanding of own mental health and emotional well-being | Has a positive experience of mental health care support and services |
| | Good mental health and well-being for all | Improved mental health |

| | | |
|---|---|---|
| | Equitable access to good quality mental health services | Equitable access to mental health services |
| | Strong public awareness and participation in matters relating to mental health and well-being, and good sectoral understanding of how to optimise it | Improved public awareness and engagement |
| | Public and corporate policy and expenditure that supports good mental health and wellbeing | Improvements in policy and legislation |
| Family, friends and relationships | A resilient society with meaningful connections | Reduction in levels of isolation/loneliness |
| | Equitable access to good quality relevant and appropriate services for family, friends and relationships for all | Improved availability of services for families |
| | Strong public awareness of the value of families, friends and relationships, and good sectoral understanding of how to build them | Improved public awareness and engagement |
| | Public and corporate policy and expenditure that supports families, friends and relationships | Improvements in policy and legislation |
| | Feels and is socially connected | Develops the level of social intimacy or connection with others that is right for them, and does not feel lonely |
| | Enjoys positive and constructive relationships with others | Enjoys appropriate and stable relationships with family and partner |
| | Has the skills, strategy and support to maintain and manage relationships | Improved communication skills |
| | Family, partners, friends and carers of those with specific needs are supported | Improved support for family members, partners, primary carers, and friends of those with specific needs |
| | Has the skills, strategy and support to maintain and manage relationships | Family members, partners and carers feel better supported and more able to live and enjoy their own lives |
| Citizenship and community | Stays within the law and has addressed any offending behaviour | Improved respect for authority, rules, law |
| | Does not discriminate against others, and is not discriminated against, on grounds of ethnicity, religion, gender, sexual orientation or disability | Improved attitude towards others from different backgrounds |
| | Understands their rights and responsibilities as a citizen | Increased knowledge of legal matters and rights |
| | Has a positive perception of local community and area | Improved overall/general perceptions of local area |
| | Strong and safe communities | Reduction in levels of crime, harassment and disorder |
| | Strong public participation in citizenship and communities, and good social cohesion | Increased rates of voting |
| | Public and corporate policy and expenditure that supports citizenship and communities | Improvements in policy and legislation |
| | Feels they have a stake in their community and society at large, and makes a conscious contribution | Increased knowledge of legal matters and rights (reporting crime) |

Source: Good Finance Outcomes and Indicators

## 7.2 Annex 2. Overview of available study designs

There are three types of study designs, experimental designs, quasi-experimental designs, and observational designs, and below we include examples of relevant research methods. This list is organised by ease of attributing causality in descending order. This list is repurposed from I4H Deliverable 2.3 and the "Sustainable intEgrated care modeLs for multi-morbidity: delivery, FInancing and performancE" (SELFIE) study.

### 7.2.1 Experimental Designs

Experimental methods involve the process of conducting controlled research to reach specific conclusions regarding a hypothesised statement. They involve random allocation of participants to different groups in an experiment, and groups are followed parallel to one another. Experimental designs are chosen because they offer a more robust design to infer causality. It is important to note the issues related to transferability of findings into real-life practice. Examples of experimental designs include a randomised controlled trial (RCT), which controls factors not under direct experimental control, and a Cluster RCT in which groups of subjects are randomised.

Table A2.1. Features of experimental designs.

| | |
|---|---|
| **Randomised Controlled Trials (RCT)** | • Patient-level randomisation to exposed (e.g. integrated care) and unexposed (e.g. usual care) groups.<br>• Prospective parallel-group comparison between exposed and unexposed groups.<br>• RCTs are not possible or desirable:<br>  o in complex interventions when controlling all factors/context is impossible and contamination between groups is likely;<br>  o if randomisation (withholding an intervention in the control group) is considered unethical;<br>  o if population in RCT not representative for real-world population.<br>• A trade-off needs to be made between internal and external validity. |
| **Cluster RCT** | • Group-level randomisation to exposed (e.g. integrated care) and unexposed (e.g. usual care) groups. Clusters of patients in a group (e.g., neighbourhood, department, GP Practice) are randomised.<br>• Randomising a group (instead of an individual) prevents contamination (how persons undergoing the intervention influence those not undergoing the intervention) and increases the logistic feasibility of implementing the intervention.<br>• The power of the design is determined by the number of clusters. If too few clusters are included, controlling by chance for all factors that might differ between groups is impeded and internal validity is compromised. |

### 7.2.2 Quasi-experimental designs

Empirical research designs that aim to establish a cause-and-effect relationship between an independent and dependent variable. Quasi-experiments do not rely on random assignments. Examples include a stepped-wedge design which is a type of RCT; propensity score matching which is a statistical matching technique to estimate the impact of an intervention; instrumental variables which estimate causal relationships when controlled experiments are not feasible; regression discontinuity which is a pretest–post-test design to evaluate programmes that have a cutoff point for participation; and difference in difference which estimate the effect of a treatment or an outcome using observational data.

Table A2.2 Features of quasi-experimental designs.

| | |
|---|---|
| **Stepped-Wedge Design** | • The stepped wedge randomised trial is a modification of the individual or cluster RCT in which the exposure (e.g., intervention) is sequentially rolled-out to all subjects over consecutive time periods.<br>• Selection bias is prevented by randomising the order by which subjects receive the exposure (e.g., intervention).<br>• Because all subjects receive the intervention ethical issues of withholding the intervention are solved.<br>• Changes in intervention based on lessons learned in previous step are possible before the next step.<br>• Possible measured effects: both short and long-term effects, fade out effects, and the natural course of the condition under study.<br>• Larger sample sizes are needed for this method to ensure enough statistical power.<br>• There may be a higher burden on participants and researchers due to necessity to repeatedly collect data. Thus, the design is most feasible if data can be (partly) routinely collected at the appropriate time intervals in a reliable and valid way.<br>• Statistical analysis is more complex since it is necessary to include a random coefficient for cluster and a fixed effect coefficient for time. |
| **Propensity Score Matching (PSM)** | • Propensity scores can be estimated using logistic regression analyses modelling the exposure as the dependent variable and the potential determinants of being exposed as independent variables.<br>• In PSM the average characteristics of the exposed versus unexposed group are similar;<br>  ○ Nearest neighbour matching: matches an unexposed individual with the closest propensity score (PS) of an exposed individual.<br>  ○ Nearest neighbour matching within a specified caliper distance.<br>  ○ Kernel weighting: each individual in the exposed group gets a weight of 1 and each unexposed patient gets a weight that depends on the distance of their PS from the PS of the exposed patients. Higher weights represent better matches.<br>• Inverse probability weighting using propensity score:<br>  ○ Uses weights based on the propensity score to create a synthetic sample in which the distribution of measured baseline covariates is independent of treatment assignment.<br>  ○ A subject's weight is equal to the inverse of the probability of receiving the treatment that the subject received. |
| **Instrumental Variable** | • In this method, it is hypothesised that an instrumental variable (IV) can 'randomise' by adjusting for measured and unmeasured confounding.<br>• This IV should be a proxy for the exposure (e.g., intervention), but cannot have a direct association to the outcome (only via the exposure), and also cannot be associated with unmeasured confounders.<br>• The ratio of the effect of the IV on the outcome on the one hand, and of the instrumental variable on the exposure on the other hand, shows the true effect of the exposure on the outcome.<br>• Choosing the correct instrumental variable is a challenge!<br>• This method is often used in trials when there is non-compliance and/or for intention to treat analyses. |
| **Regression Discontinuity Design (RDD)** | • This method can be used when there is some kind of criterion that must be met before subjects can be exposed (i.e. included in an intervention).<br>• In RDD, the exposure (e.g., intervention group) is assigned to subjects that score [just] above a certain 'cut-off point' (on a continuous variable); and the unexposure (e.g., control group) is made up of individuals that score [just] below that cut-off point.<br>• The main assumption in RDD is that individuals that just score on either side of the 'cut-off point' or threshold, belong to the same population. Allocation of these subjects to either exposed or unexposed is therefore considered 'random' – assuming that subjects cannot manipulate the threshold value.<br>• Intervention effects are estimated by comparing the outcomes of the group that meets the criterion with the group that just not meets the criterion using regression techniques: non-parametric (local linear regression) or parametric (polynomial regression).<br>• Assumption that individuals around threshold are similar is often debatable.<br>• The design requires larger sample sizes than an RCT to achieve sufficient statistical power.<br>• Data collection required for all individuals considered for intervention (also those who are not included in the intervention). |
| **Difference in Differences** | • Also known as 'double difference' method, compares changes in the outcome over time between two groups (i.e., exposed and unexposed) to estimate an effect. This way the difference at baseline between the groups is 'removed'.<br>• It assumes that the outcomes of interest in the unexposed group follow the same trend over time as the outcomes would do in the exposed group in the absence of the intervention; thus that there is no confounder that influences one group and not the other.<br>• The assumption of parallel trends between intervention and control groups can be relaxed in a differential trend model. |

### 7.2.3 Observational Designs

Observational studies look at the effect of an intervention without manipulating who is or is not exposed to it. It answers the research question on what the researcher observes and there is no interference. Observational designs include a cohort study which samples a group of people who share a defining characteristic or a common event; a case control study in which groups of participants with and without a condition of interest are identified and compared; and interrupted time series analysis which is a method of statistical analysis involving tracking a long-term period before and after a point of intervention to assess the intervention's effectiveness.

Table A2.3 Features of observational design

| | |
|---|---|
| **Cohort Study** | • The starting point in such studies is the selection of a study population, or a cohort study.<br>• Information is obtained to determine which persons in this cohort are exposed to a specific factor, and which are not (e.g., which persons participated in an integrated care programme, and which did not).<br>• Allocation of participants to either group (exposed vs. unexposed) is not influenced by the investigator.<br>• Outcomes can be collected prospectively or retrospectively. |
| **Case Control Study** | • The starting point here is the identification of 'cases' and 'controls' (outcome present or not present).<br>• Then go back and look at which cases and which controls were exposed vs. unexposed (i.e., participated in an integrated care programme versus usual care).<br>• There is also the possibility to do a nested case-control study, in which a subset of controls are matched to cases. X controls are matched to a single case based on certain characteristics, making this a more efficient model |
| **Interrupted Time Series** | • Repeated measurements are performed before and after exposure at population level in order to detect whether the intervention has a greater effect than the underlying secular trend (e.g., economic, market, or demographic trend) .<br>• Determining whether the intervention had a larger effect than any underlying trend is estimated by comparing the trend in the outcome after the intervention to the trend in the pre-intervention period.<br>• Relevant design when using routinely collected data (e.g., insurance data) and when looking at macro interventions.<br>• Pros: allows for control over secular trends, ability to evaluate outcomes at population-level, clear graphical presentation of results (see next slide), ability to do stratified analyses and look at intended and unintended consequences of interventions.<br>• Cons: multiple measurement waves are needed (circa 8 before and after exposure (i.e., implementation), had to look at specific elements of exposure. |

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