**Biomarker Minimum Information**

This document describes the minimum information required to report a biological marker. Biomarkers are any biological characteristics that can serve as indicators in a certain context, that is, for a specific disease and purpose. Therefore, it is important to describe the exact circumstances under which the biomarker is relevant.

Main resources for defined requirements are:

# BEST (Biomarkers, EndpointS, and other Tools) Resource : <https://www.ncbi.nlm.nih.gov/books/NBK326791/>

* Biomarker consortium: <https://fnih.org/what-we-do/biomarkers-consortium>
* Biomarker qualification guidelines (for development of markers)

<https://www.fda.gov/media/119271/download>

<https://fnih.org/sites/default/files/final/pdf/Evidentiary%20Criteria%20Framework%20Final%20Version%20Oct%2020%202016.pdf>

**Suggested minimal required information for biomarkers / disease-biomarker association**

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| --- | --- | --- | --- |
| **Attribute** | **Explanation** | **Examples** | **References or related ontologies** |
| Label | Name of biomarker | Molecular: name of a biological entity (or entities) - gene/protein/metabolite/other molecule/variant  Physiological: blood pressure, heart rate  Imaging: usually name of imagine technique (CT,PET,OCT) |  |
| Concept | High level definition, reflects the complexity of the biomarker | **Single** – consists of one measurement  **Composite** – consists of multiple measurements with a single output  **Complex** – consists of multiple independent measurements of multiple biological entities measured separately | [FDA Qualification Plan](https://www.fda.gov/media/120059/download) |
| Disease | Disease or condition related to the marker | Breast cancer | [HDO](http://purl.obolibrary.org/obo/DOID_4)  [EFO](http://www.ebi.ac.uk/efo/EFO_0000408) |
| Usage | The purpose of the biomarker | **diagnostic** – to detect or confirm presence of a disease or condition  **monitoring** – to assess the status of a disease (serially measured)  **prognostic** - identify likelihood of a clinical event, disease recurrence or progression of disease  **predictive** -  to identify individuals who are more likely to respond to exposure to a particular medical product or environmental agent  **pharmacodynamic**/**response** – to assess response to a treatment /medical product or an environmental agent  **susceptibility**/**risk -** indicates the potential for developing a disease or medical condition in an individual who does not currently have clinically apparent disease or the medical condition.  **safety -** measured before or after an exposure to a medical product or an environmental agent to indicate the likelihood, presence, or extent of toxicity as an adverse effect  [ + surrogate endpoint – used in clinical trials] | [BEST](https://www.ncbi.nlm.nih.gov/books/NBK326791/) |
| Type | Type of a single or composite biomarker | From [biomarker definition](https://www.ncbi.nlm.nih.gov/books/NBK338448/def-item/glossary.biomarker/) of FNIH :  Molecular, histologic, radiographic, physiologic | [BEST Glossary](https://www.ncbi.nlm.nih.gov/books/NBK338448/def-item/glossary.biomarker/) |
| Source or Location | Source of sample, materials for measurement or location in the body where the measurement is taken | [Organism substance](http://purl.obolibrary.org/obo/UBERON_0000463) : [bodily fluid](http://purl.obolibrary.org/obo/UBERON_0006314), [bodily gas](http://purl.obolibrary.org/obo/UBERON_0034873), [excreta](http://purl.obolibrary.org/obo/UBERON_0000174)  [Tissue](http://purl.obolibrary.org/obo/UBERON_0000479)  [organ](http://purl.obolibrary.org/obo/UBERON_0000062)  e.g. blood, image of skull, dermal-epidermal junction, cortical kidney tissue | [FDA Qualification Plan](https://www.fda.gov/media/120059/download)  (section III B – measurements of the biomarkers)  UBERON  [Material anatomical entity](http://purl.obolibrary.org/obo/UBERON_0000465) |
| Assay, Test or Tool | An analytic procedure for detecting or measuring the presence, amount, state or functional activity of a [biomarker](https://www.ncbi.nlm.nih.gov/books/NBK338448/def-item/glossary.biomarker/). Technologies or instruments used, medical device | Examples from NCIT ontology:  [Pulse Wave Velocity](http://purl.obolibrary.org/obo/NCIT_C122087)  [Bone Marrow Biopsy](http://purl.obolibrary.org/obo/NCIT_C15193)  [Polymerase Chain Reaction](http://purl.obolibrary.org/obo/NCIT_C17003)  [Microarray Analysis](http://purl.obolibrary.org/obo/NCIT_C18477)  [Magnetic Resonance Imaging](http://purl.obolibrary.org/obo/NCIT_C16809) | [BEST Glossary](https://www.ncbi.nlm.nih.gov/books/NBK338448/def-item/glossary.assay/)  [NCIT](http://purl.obolibrary.org/obo/NCIT_C16203) (Intervention or Procedure -> Diagnostic procedure, laboratory procedure)  [OBI](http://purl.obolibrary.org/obo/OBI_0000070) (only molecular assays, linked to many other ontologies) |
| Evidence | Evidence of the marker-disease association from literature | Sentence/reference/PMID |  |
| Evidence level | Status | Experimental/qualified/validated/in clinical use |  |
| **For molecular markers:** | | | |
| Type | Molecular type | High level definition: genomic/proteomic/metabolomic ([reference](http://www.cancerjournal.net/article.asp?issn=0973-1482;year=2016;volume=12;issue=2;spage=486;epage=492;aulast=Santosh))  Or more detailed : gene expression, gene activation, variation, genomic location, protein,peptide,DNA,RNA,miRNA, |  |
| Associated biological entities | Describes the related entity(ies) being measured | Uniprot id, HGCN name, dbSNP,Ensemble, chembl, etc. |  |
| **For Predictive & Pharmacodynamic/Response markers:** | | | |
| Treatment | Medical product, therapy | [dietary sodium intake avoidance](http://purl.obolibrary.org/obo/MAXO_0010096) [trastuzumab](http://purl.obolibrary.org/obo/NCIT_C1647) | Chemical Entities of Biological Interest (CHEBI)  Medical Action Ontology (MAXO)  NCIT |

Remarks:

* Some molecular markers like mutations/variants and protein are associated with a gene as well
  + Complex biomarkers will be associated with several markers (can also be of different types)
* Digital biomarkers <https://www.karger.com/Article/FullText/502000#ref2>

Examples:

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| Name | Type | Disease | Usage | type | source | Assay, tool/technology | evidence |
| Arterial stiffness | Single | Cardiovascular Disease (CVD) | Risk | physiologic | finger | Aortic pulse wave velocity (Aortic PWV) | 16461838 |
| PDG-PET | Single | Alzheimer | Diagnostic | imaging | brain | Brain glucose metabolism, FDG-Positron Emission Tomography | 31253185 |
| IL-6 | Single | hepatocellular carcinoma (HCC) | Diagnostic | Molecular  Protein | serum | Serum protein levels | 23082483 |
| Blood pressure | Single | hypertension | pharmaco-dynamic | physiologic | arm | Systolic and diastolic pressure | 24352797 |
| AKT  overexpression | Single | Breast cancer | predictive | Molecular  Gene/transcript | tumor tissue | Gene expression profiling Immunohistochemistry  Tissue microarrays | 22842582 |
| ER-PR-HER2 | Composite | Breast cancer | Prognostic/predictive | Molecular  Gene/transcript | tumor tissue | Gene expression profiling Immunohistochemistry  Microarray | 20107892 |
| OGG1- POLG- NDUFV2 | Composite | Biopolar disorder | diagnostic | Molecular  Gene/transcript | blood | Gene expression profiling  Ficoll-Paque-PLUS  NanoDrop PCR | [26241352](https://www.ncbi.nlm.nih.gov/pubmed/26241352) |