Types of Biobanks

3

Svetlana Gramatiuk and Berthold Huppertz

Abstract

As already introduced in Chap. 1, a biobank is a type of biorepository where biological samples, usually of human nature, are stored for research. Like described before, the term "biobank" can be defined as a collection of human biological samples and related data. These samples and data are systematically organized for research purposes. While the collection of biospecimens from other living organisms can also be called a biobank, many prefer to use this term only for human biospecimens. Both the terms "biobanks" and "biorepositories" are conceptually compatible. In this chapter, you will learn more about different classifications of biobanks—for example, biobanks can be classified based on different approaches, they can also differ in scale, quality, subject matter, and participants, and some collections can be defined by donor arrangement.

Keywords

Classification of biobanks · Biobank versus biorepository · Population-based · Disease-oriented · Institution- or clinic-based · Biobanks of network projects

At the first stage of introducing and comparing different classifications and types of biobanks, it is necessary to clarify that, from the point of view of biobanks and biorepositories, "biobank" and "biorepository" are compatible by concepts [1–5]. The term "center of biological resources" was used for "biobanks" when

---

S. Gramatiuk
Institute of Cellular Biorehabilitation, Kharkiv, Ukraine

B. Huppertz (✉)
Division of Cell Biology, Histology and Embryology, Gottfried Schatz Research Center, Medical University of Graz, Graz, Austria
e-mail: berthold.huppertz@medunigraz.at

K. Sargsyan et al. (eds.), *Biobanks in Low- and Middle-Income Countries: Relevance, Setup and Management*, https://doi.org/10.1007/978-3-030-87637-1_3

conducting cancer research. Additionally, biobanks are also providers of medical research services in general; thus, "biobanks" are not only collecting human biological material, but the term is used in a much wider sense [1, 2, 4–8].

The National Cancer Institute in the United States of America has described the often-used definition "biorepository" as an especially organized abode or building in which biological substances, under certain temperature conditions, are stored [9, 10]. With the same meaning, the term "biobank" was used by further American and European organizations [10, 11].

A taxonomy of types of biobanks can be made if the systematic interaction of a biobank with its participants is the basis of the differentiation. Among others, there are differently typified categories of biorepositories like *population-based, disease-oriented, institution- or clinic-based, biobanks of network projects, moved along by the course of the host organizations, or national public ones* [12–17].

Biobanks also differ in scale, quality, subject matter, and participants. Some definitions refer to the ground stage and stage of development of biobanks. There can be "*radically converse opinions over how fixed reputation should be recognized, formulated, explained, or high-spirited...*" [13, 18, 19].

Human biorepositories have a specific classification [20]:

- *Tissue type*: (tumor and/or other benign tissues, blood, RNA, or DNA, etc.).
- *Topic*: Planned application or purpose (scientific investigation, therapy like transplantation (may be also forensics) can be the origin for therapeutic procedures such as umbilical material, stem cell, also investigation or monitoring of therapy, etc.) [7, 8, 14].
- *Ownership*: Universities or other academic institutions and academic groups, clinics, pharmaceutical companies as well as biotechnology industries, biobanking networks, or societies (e.g., rare disease biobanks and all others that have funds, to be able to sustain a biobank). Ownership can be in co-partnership, public but also private, through area and field borders (proprietorship is sometimes general, or based on performance in company).

The collection can also be defined by donor arrangement (inhabitants: adults, pregnant women, sick people, newborn, contain limited types and diagnosis) [19]. They can also be differentiated by the size of collection spread (condition based on one clinic, cross-sectional in public, state-wide, or in one city).

Gottweis and Zatloukal [16] distinguish four categories of human biobanks:

- *Clinical case-controlled biobanks* built up with human material of individuals having given diagnosis and correspondingly healthy controls. A nice example is the pathology archive. These kinds of "biobanks" are confronted with huge challenges, as archives such as those initiated in pathologies often do not follow strict ethical guidelines for scientific usage (e.g., ethical approval or informed consent).
- *Longitudinal population-based biobanks*, which monitor a concrete and defined part of a given group of inhabitants living in a specific region for a long time (e.g., *the Estonian and UK Biobank*).

- *Isolated population biobanks*, which are characterized by a consistent genetical basis as well as ecological circumstances for a target population (e.g., *the Icelandic Biobank*).
- *Twin registries* are characterized as a collection of human biological material derived from twins (independently if dizygotic or monozygotic) (e.g., *the GenomEUtwin and the Swedish Twin registry*).

Rebulla et al. [21, 22] make the categorization of biobanks more advanced. They distinguish between six classified types of biobanks:

- "*Leftover tissue biobanks*" *collected during clinical pathology diagnostic procedures*
- *Population biobanks*
- *Twin biobanks*
- *Disease biobanks from patients suffering specific conditions*
- *Organ biobanks*
- *Nonhuman biobanks* (e.g., *"Primate Brain Bank")*

Currently, a comprehensively acknowledged classification is introduced by *BBMRI* [19, 23, 24] that differentiates between two specific categories of biorepositories:

- *Population-based biobanks* (population-based biorepositories, which are prospectively oriented on the observation (survey) of the usual way of life and detection of diseases and/or their complications over a long period)
- *Disease-oriented biobanks* (human biological samples such as tissue samples and corresponding diagnostic data are usually available for biomedical research that are more complex and clinically relevant)

References

1. Organization for Economic Cooperation and Development. (2007). *OECD best practices guidelines for biological resource centers*. Retrieved from http://www.oecd.org/sti/emerging-tech/oecdbestpracticeguidelinesforbiologicalresourcecentres.htm
2. Vaught, J., Rogers, J., Carolin, T., & Compton, C. (2011). Biobankonomics: Developing a sustainable business model approach for the formation of a human tissue biobank. *JNCI Monographs, 2011*(42), 24–31. https://doi.org/10.1093/jncimonographs/lgr009
3. Gaffney, E. F., Madden, D., & Thomas, G. A. (2011). The human side of cancer biobanking. *Molecular Profiling, 2012*(823), 59–77. https://doi.org/10.1007/978-1-60327-216-2_5
4. OECD. (2014, January). *Emerging technologies. Guidelines for human biobanks and genetic research databases (HBGRDs)*. Retrieved from http://www.oecd.org/sti/emerging-tech/guidelines-for-human-biobanks-and-genetic-research-databases.htm
5. OECD Organization for Economic Cooperation and Development. (2010). OECD guidelines on human biobanks and genetic research databases. *European Journal of Health Law, 17*(2), 191–204.

6. National Cancer Institute, National Institutes of Health, U.S. Department of Health and Human Services. (2007, June). *National Cancer Institute best practices for biospecimen resources*. Retrieved from https://biospecimens.cancer.gov/bestpractices/2007-NCIBestPractices.pdf
7. Botti, G., Franco, R., Cantile, M., Ciliberto, G., & Ascierto, P. A. (2012). Tumor biobanks in translational medicine. *Journal of Translational Medicine, 10*(204). https://doi.org/10.1186/1479-5876-10-204
8. Hanif, Z., Sufiyan, N., Patel, M., & Akhtar, M. Z. (2018). Role of biobanks in transplantation. *Annals of Medicine and Surgery, 28*, 30–33. https://doi.org/10.1016/j.amsu.2018.02.007
9. Colledge, F., Elger, B., & Howard, H. C. (2013). A review of the barriers to sharing in biobanking. *Biopreservation and Biobanking, 11*(6), 339–346. https://doi.org/10.1089/bio.2013.0039
10. National Cancer Institute. (2016). *NCI Best practices for biospecimen resources*. Retrieved July 22, 2018, from biospecimens.cancer.gov/bestpractices/2016-NCIBestPractices.pdf
11. Campbell, L. D., Astrin, J. J., DeSouza, Y., Giri, J., Patel, A. A., Rayley-Payne, M., Rush, A., & Sieffert, N. (2018). The 2018 revision of the ISBER best practices: Summary of changes and the editiorial Team's development process. *Biopreservation and Biobanking, 16*(1), 3–6. https://doi.org/10.1089/bio.2018.0001
12. Colledge, F., Persson, K., Elger, B., & Shaw, D. (2013). Sample and data sharing barriers in biobanking: Consent, committees, and compromises. *Annals of Diagnostic Pathology, 18*(2), 78–81. https://doi.org/10.1016/j.anndiagpath.2013.12.002
13. Fortin, S., Pathmasiri, S., Grintuch, R., & Deschênes, M. (2011). 'Access arrangements' for biobanks: A fine line between facilitating and hindering collaboration. *Public Health Genomics, 14*(2), 104–114. https://doi.org/10.1159/000309852
14. Luque, J. S., Quinn, G. P., Montel-Ishino, F. A., Arevalo, M., Bynum, S. A., Noel-Thomas, S., Wells, K. J., Gwede, C. K., Meade, C. D., & Tampa Bay Community Cancer Network Partners. (2012). Formative research on perceptions of biobanking: What community members think. *Journal of Cancer Education, 27*(1), 91–99. https://doi.org/10.1007/s13187-011-0275-2
15. Mascalzoni, D., Dove, E. S., Rubinstein, Y., Dawkins, H. J., Kole, A., McCormack, P., Woods, S., Riess, O., Schaefer, F., Lochmüller, H., Knoppers, B. M., & Hansson, M. (2016). International charter of principles for sharing biospecimens and data. *European Journal of Human Genetics, 24*(7), 1096. https://doi.org/10.1038/ejhg.2015.237
16. Gottweis, H., & Zatloukal, K. (2007). Biobank governance: Trends and perspectives. *Pathobiology, 74*(4), 206–211. https://doi.org/10.1159/000104446
17. Downey, P., & Peakman, T. C. (2008). Design and implementation of a high-throughput biological sample processing facility using modern manufacturing principles. *International Journal of Epidemiology, 37*(1), i46–i50. https://doi.org/10.1093/ije/dyn031
18. Brisson, A. R., Matsui, D., Rieder, M. J., & Fraser, D. D. (2012). Translational research in pediatrics: Tissue sampling and biobanking. *Pediatrics, 129*(1), 153–162. https://doi.org/10.1542/peds.2011-0134
19. Friede, A., Grossman, R., Hunt, R., Li, R. M., & Stern, S. (Eds.). (2003). *National Biospecimen Network Blueprint*. Constella Group.
20. BioMedInvo4All. (2018). Retrieved July 22, 2018, from www.biomedinvo4all.com/en/research-themes/medical-data-and-biobanks/medical-data-and-biobanks-basics
21. Rebulla, P., Lecchi, L., Giovanelli, S., Butti, B., & Salvaterra, E. (2007). Biobanking in the year 2007. *Transfusion Medicine and Hemotherapy, 34*, 296–292. https://doi.org/10.1159/000103922
22. Albert, M., Bartlett, J., Johnston, R. N., Schacter, B., & Watson, P. (2014). Biobank bootstrapping: Is biobank sustainability possible through cost recovery? *Biopreservation and Biobanking, 12*(6), 374–380. https://doi.org/10.1089/bio.2014.0051
23. BBMRI-ERIC. (2021). Retrieved March 12, 2021, from http://www.bbmri-eric.eu/
24. CORDIS. (2015). *Biobanking and biomolecular resources research infrastructure*. Retrieved July 22, 2018, from https://cordis.europa.eu/result/rcn/162431_de.html