EUROPEAN JOURNAL OF TRANSLATIONAL
AND CLINICAL MEDICINE 2019;2(1):85-95

BIORESOURCE PAPERS

Biobank Łódź® – population based biobank at the University of Łódź, Poland

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Abstract

Background: Biobank Laboratory of the University of Łódź is a unit in the organizational structure of the Department of Molecular Biophysics at the Faculty of Biology and Environmental Protection. It was established in 2014 as one of the results of the TESTOPLEK project. One of the main goals of the unit is to collect and share biological material of human origin and related clinical and survey data. Moreover, Biobank Laboratory conducts work in the field of genetics and molecular biology on human biological material. Biobank Laboratory gathers over 40.000 samples such as DNA, FFPE, saliva, together with their data. Data about its material is available for researchers in directories e.g. BBMRI-ERIC Directory 4.0. Since 2014, the unit belongs to the national Consortium BBMRI.pl, and since 2017 it executes a project entitled Research Infrastructure for Biobanks and Biomolecular Resources BBMRI-ERIC, co-creating the Polish Network of Biobanks. Biobank Laboratory is focused on cooperation with domestic and foreign scientific institutions and medical units, as well as entities from the local, business and public sector.

Keywords: biobank • population biobank • sample quality control • BBMRI-ERIC • data

Citation

Dobrowolska S, Michalska-Madej J, Słomka M, Sobalska-Kwapis M, Strapagiel D. Biobank Łódź – population based biobank at the University of Łódź, Poland. Eur J Transl Clin Med. 2019;2(1):85-95.
DOI: 10.31373/ejtcm/109495

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Funding source: This work was supported by the Polish Ministry of Science and Higher Education—Project DIR/WK/2017/01.

Available online: www.ejtcm.gumed.edu.pl

Introduction

Biobank name

Biobank Laboratory, Department of Molecular Biophysics, Faculty of Biology and Environmental Protection, University of Łódź [1].

Biobank ID

Biobanking directory: BBMRI-ERIC Directory 4.0 [2].
ID: PL_BLUL

Biobank contact

- Address: 14/16 Józefa Pilarskiego Street, 90-231 Łódź, Poland
- URL: www.biobank.uni.lodz.pl
- e-mail: biobank@uni.lodz.pl
- Phone number: +48 42 665 57 02
- Corresponding person: Dr. Dominik Strapagiel, dominik.strapagiel@biol.uni.lodz.pl

Biobank history

Biobank Laboratory of the University of Łódź is a unit in the organizational structure of the Department of Molecular Biophysics at the Faculty of Biology and Environmental Protection, established by the Resolution of the Dean of the Faculty of Biology and Environmental Protection of 25/03/2014.

Biobank Laboratory was created as one of the results of the TESTOPLEK project – full name *Role of multidrug resistance proteins in pharmacokinetics and toxicology – in vitro tests in pharmaceutical and clinical practice* (2008-2014) [3-5].

Over 10.000 individuals nationwide were canvassed to create a retrospective POPULOUS collection (POPUlation – LOdz UniverSity Biobank). The next step was the acquisition of collections of clinical samples, including breast cancer patients (BREAST), patients with pancreatic cancer (PANC), as well as a representative collection of samples from the school-age population from the city of Łódź (PUPILS).

Since 2014, the unit belongs to the national Consortium BBMRI.pl, and since 2017 it executes a project entitled Research Infrastructure for Biobanks and Biomolecular Resources BBMRI-ERIC (Biobanking and BioMolecular Resource Research Infrastructure - European Research Infrastructure Consortium), co-creating the Polish Network of Biobanks [1, 6-7].

Biobank legal status

Public; a part of Department of Molecular Biophysics, Faculty of Biology and Environmental Protection, University of Łódź [8-9].

Current biobanking activity

Longitudinal study; collecting; processing; storage.

Main biobank aim

One of the main goals of the unit is to collect and share biological material of human origin and related clinical and survey data. Moreover, Biobank Laboratory conducts work in the field of genetics and molecular biology on human biological material.

Biobank membership

- BBMRI.pl (Biobanking and BioMolecular resources Research Infrastructure – Consortium) [6],
- BCNet (Biobank and Cohort Building Network) [10],
- ESBB (European and Middle Eastern Society for Biopreservation and Biobanking) [11],
- co-creating the Polish Network of Biobanks [6].

Certification

Biobank Laboratory has European certificates from IBBL (Integrated Biobank of Luxemburg) [12] in the fields of:

- DNA Quantification and Purity,
- RNA Quantification and Purity,
- DNA Extraction from Whole Blood,
- RNA Extraction from Whole Blood,
- Microbial DNA Extraction from Saliva,
- CSF Aliquoting [13].

Some employees of the unit have certification as lead auditors in the field of information security and quality management granted by leading international and national centres [14].

International system standards

In the near future Biobank Laboratory plans to implement international standards related to management systems, such as PN-EN ISO 9001:2015 Quality management systems – Requirements and PN-EN ISO/IEC 27001:2017 Information security management system – Requirements.

Scientific and research projects

TESTOPLEK: *Role of multidrug resistance proteins in pharmacokinetics and toxicology – in vitro tests in pharmaceutical and clinical practice* – POIG grant 01.01.02-10-005/08 TESTOPLEK from the European Regional Development Fund (2008-2014).

BBMRI: *Research Infrastructure for Biobanks and Biomolecular Resources BBMRI-ERIC* – Polish Ministry of Science and Higher Education no. DIR/WK/2017/01 (2017-2021).

POPC: *Digital sharing of biomolecular and descriptive resources of Biobank and Department of Anthropology, University of Łódź – characteristics of populations living in present-day Poland through the ages. Information platform e-Czlowiek.pl* – Polish Ministry of Science and Higher Education no. DIR/WK/2017/01 (Operational Programme Digital Poland for 2014-2020).

Let`s BioIT: *Let's Bio-IT development of professional, bioinformatic, language and entrepreneurial skills of students of the Faculty of Biology and Environmental Protection, University of Łódź* – Project no. POWR.03.01.00-00-K410 / 16-00 (2017-2019).

POLPHARMA: *The study of the importance of epigenetic processes in the pathogenesis of mastocytosis to find new therapeutic options* founded by Polpharma Scientific Foundation (2018-2021).

Organization structure of biobank

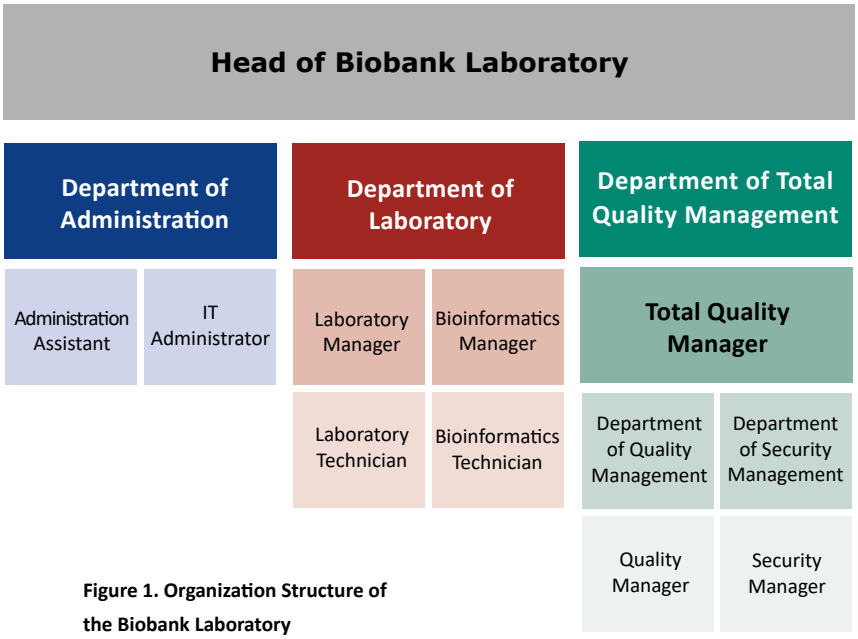

Figure 1. Organization Structure of the Biobank Laboratory

Percentage share of the type of biobanked material Collections

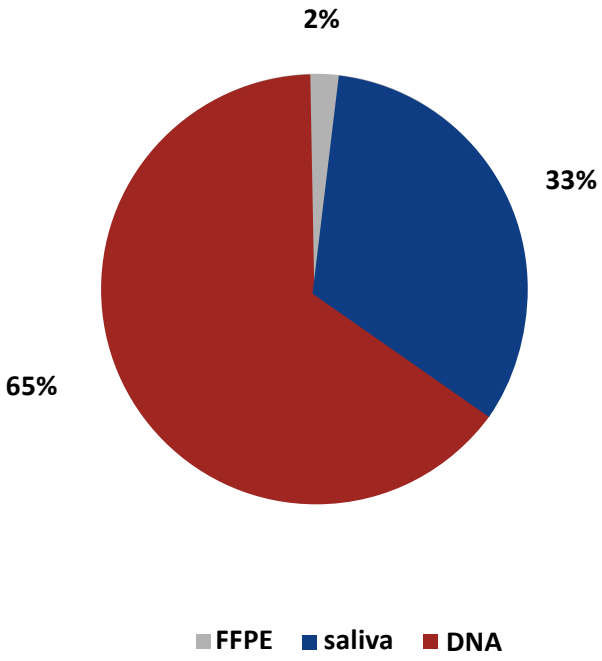

Figure 2. Percentage share of the type of biobanked material

Collection and sample

Biobank category	*Material type*
Population based	Saliva; DNA; FFPE

POPULOUS – saliva; DNA; the collection was created for the project TESTOPLEK; retrospective; anonymized; POPULOUS_BLUL [3-4, 15-23].

BREAST – FFPE; DNA; the collection was created for the project TESTOPLEK; retrospective; anonymized; BREAST_CANCER_COLLECTION_BLUL.

PANC – DNA; saliva; the collection was created for the project TESTOPLEK; retrospective; anonymized; PANCREATIC_CANCER_COLLECTION_BLUL.

PUPILS – saliva; the collection was created within a grant from the Mayor of the City of Łódź (559/VI/11) and project TESTOPLEK; prospective; pseudoanonymized; ANTHROPOLOGICAL_STUDY_PUPILS_BLUL [5, 24-28].

BREAST IBUL – DNA; retrospective; anonymized [29-31].

Geographical origin of samples from the collection

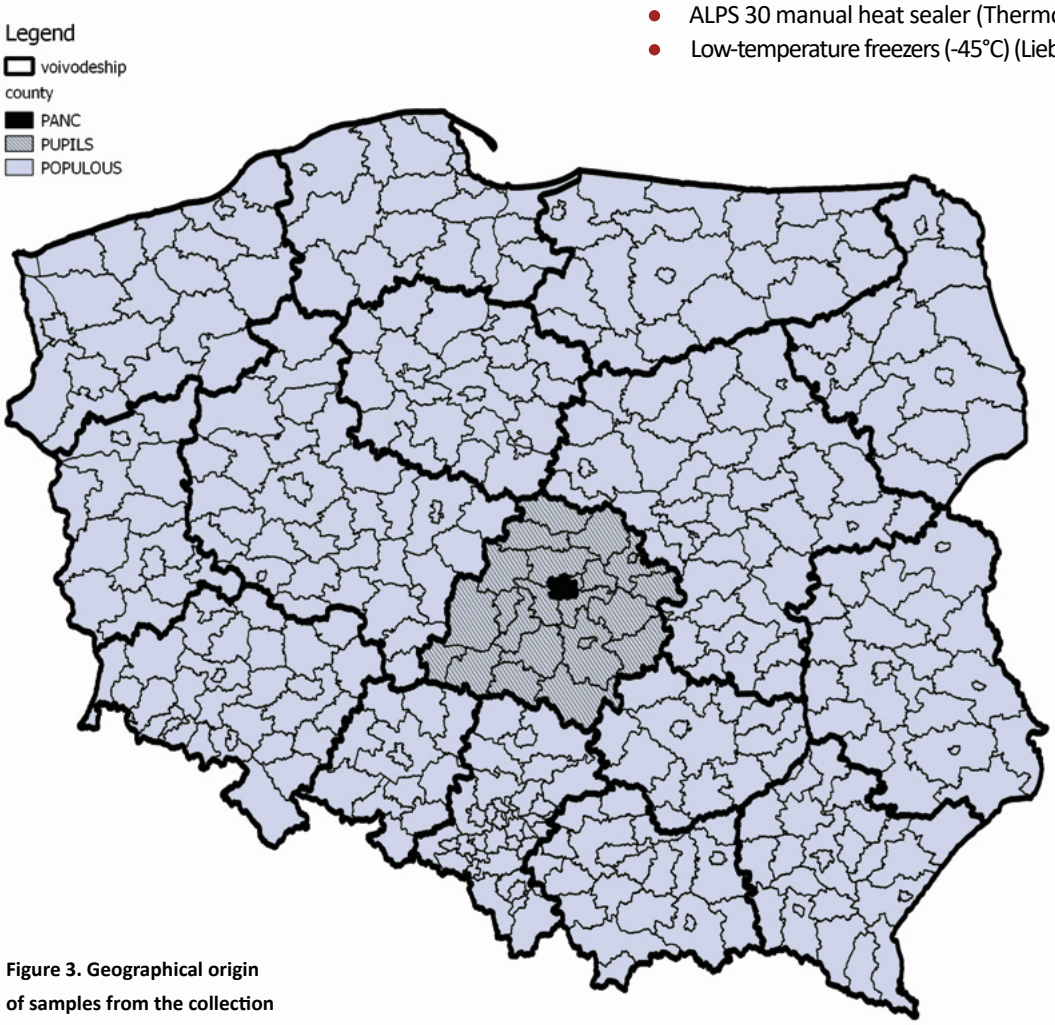

Figure 3. Geographical origin of samples from the collection

BREAST and BREAST IBUL collection have no specific information about geographical origin of donors [32-33].

Characteristics of samples in collection

Description of material collected in collections, according to Table 1.

Storage conditions

-50°C; -27°C; room temperature (18-25°C)

Biobank Equipment

- NextSeq500 (Illumina Inc.),
- MinION (Oxford NanoPore Technologies),
- Liquid Handling Robot Janus (Perkin Elmer),
- Liquid Handling Robot MagNa Pure LC 2.0 (Roche),
- Automatic arm for transferring microplates (LabMind),
- TECAN Workstation (Illumina Inc.),
- Scanner iScan (Illumina Inc.),
- ALPS 30 manual heat sealer (Thermo Scientific),
- Low-temperature freezers (-45°C) (Liebherr Medline),
- Low-temperature freezers (-86°C) (New Brunswick Scientific),
- UV3 HEPA PCR Workstations (UVP),
- Laminar Workstations Maxi Safe 2020 (Thermo Scientific),
- Chamber for long storage of DNA in room temperature (BioMatrica),
- ThermalCycler C1000 (BioRad),
- CFX Real-Time PCR Thermal Cycler C1001 (BioRad),
- Automatic sample sorter XL20 (BioMicroLab),
- LightScanner (IDAHO Technology)
- Milli-Q (Millipore),
- DNA microplates decapper (Polgen),
- Single TEC control (INHECO),
- Hybex microsample incubators (SciGene),
- Hybridization ovens (Illumina Inc.),
- Qubit 2.0 Fluorometer 2.0 (Invitrogen),

- FastGene Mini centrifuge (NipponGenetics Europe),
- Centrifuge MPW-352R (MPW),
- Pippin Prep (Sage Science).

Donors

POPULOUS – no information about diagnosis, available donor declarations about their diseases (Tumors of soft tissues; Symptomatic atherosclerosis of coronary vessels not treated with stents; Diabetes; Hypothyroidism; Psoriasis; Lung cancer; LDL-C hypercholesterolemia above 130 mg / l; Multiple sclerosis; Symptomatic atherosclerosis of coronary vessels treated with stents; Hyperplasia of the prostate gland; Malignant Hematoma and Non-Hodgkin's Lymphoma; Head and neck region cancer; Breast cancer; Allergy; Myasthenia gravis; Male genital cancers; Cancer of the urinary tract; Osteoporosis; Gastrointestinal neoplasms; Tumors of female genital organs; Leukemia; Thyroid cancer; Tuberculosis, including multi-drug resistant tuberculosis and other mycobacteriosis; Condition after myocardial infarction; Rheumatic diseases; Epilepsy; Parkinson's disease and syndrome; Alzheimer's disease; Asthma, Chronic obstructive pulmonary disease, eosinophilic bronchitis; Ulcerative colitis and Crohn's disease; Atherosclerosis; Condition after transplantation of a vascularized organ or bone marrow; Peptic ulcer disease – Helicobacter pylori infection detected and treated; Melanomas and skin cancers; Glaucoma); male and female; 18-90 ages.

BREAST – diagnosis: breast cancer / Malignant neoplasm of breast (C50-C50); female; available medical records, information about diagnosis and treatment.

PANC – diagnosis: pancreatic cancer / Malignant neoplasm of pancreas (C25); available medical records, information about diagnosis.

PUPILS – lack of information about diagnosis, available donor declarations about their diseases; male and female; ages 6-16.

BREAST IBUL - diagnosis: breast cancer / Malignant neoplasm of breast (C50-C50); female; available medical records, information about diagnosis.

Directories

- BBMRI-ERIC Directory 4.0 – information about collection [2],
- BioFace – information about biobank's samples,
- e-Człowiek platform – information about anthropological collection,
- metaBiobank – information about collection [34].

Communication protocol

- BioScoop 1.0 – communication protocol used for BioFace and e-Człowiek platform [35],
- Miabis 2.0 – communication protocol used for BBMRI-ERIC Directory 4.0 [36].

Principles of sharing samples and materials

In order to gain access to biobanked samples, please contact the Biobank Laboratory Manager and present the context of the use of samples in research. The request is subsequently evaluated in terms of formal, legal and ethical compliance with the rules of Biobank Laboratory and Polish law. Following a positive decision, the material is anonymized and transmitted to researcher. Each transfer of samples is contingent upon signing an MTA (Material Transfer Agreement) in which the nature of the access is determined. The researcher may use the samples only for the purposes specified in the MTA.

Samples management system

For the needs of the TESTOPLEK project, Biobank Laboratory created its own system of sample management (SMS). At present, Biobank Laboratory as a member of Polish Biobank Network uses BBMS (BioBank Management System) to manage samples. The SMS system is still used as a form of verifying the correctness of data migration to BBMS [37].

Quality control of samples

Quality control of biobanking samples is based on internal quality procedures (SOP – Standard Operational Procedure). At every step, samples are evaluated by quality tests. Each internal method is verified and validated by qualified Biobank staff. Quality procedures are based on generally accepted standards and the experience and knowledge of employees.

In addition, selected internal biobank procedures are evaluated by external quality tests – Proficiency Testing Program performed by IBBL (Integrated BioBank of Luxembourg) to confirm their quality. The pro-quality testing program is endorsed by ISBER (International Society for Biological and Environmental Repositories) [12, 38].

Collection and samples databases

Format of shared data

Format of genetics/raw sequencing shared data:

- .fastq
- .ped
- .map
- .bam

Format of medical shared data:

- .csv

Format of image shared data:

- .jpg
- .tiff
- .S3Dm

External repository of data

- e-Człowiek.pl platform,
- EGA – European Genome-phenome Archive [39],
- SRA – Sequence Read Archive (available on NCBI) [40],
- WGS – Whole genome sequencing (available on NCBI) [40],
- BioProject (available on NCBI) [40],
- BioSample (available on NCBI) [40].

Principles of sharing data

All data stored by the Biobank Laboratories are subject to strict access control. Access to data can be obtained on the basis of individually negotiated licensing agreements – DTA (Data Transfer Agreement). The DTA determines the detailed scope of data access and processing capabilities. Depending on the scope of the DTA, additional contracts may be required. Shared data should be kept confidential and should only be used for tasks related to the implementation of the agreement. In order to obtain access to data, please contact the Manager of the Biobank Laboratory specifying the use of the data.

Ways of sharing data

Encoded external disc, FTP servers, commercial data sharing services.

Data management system

BBMS – BioBank Management System [37].

Ethics

Institutional Review Board

Any activity that uses biological material collected by the Biobank Laboratory is controlled by the Institutional Review Board of the University of Łódź (IRB). The Head of Biobank Lab is an active member and participates in the legislative work of the IRB.

In order to use the material each researcher should submit an appropriate application to the IRB. IRB gives its opinion on the proposal in terms of its scientific validity and feasibility, and respecting the rights of participants in the research experiment.

After receiving a positive opinion from the IRB, the researcher may start recruiting donors to create a new collection or start research on the already created collection.

Regulations

Every activity of the Biobank Laboratory in the area of biobanking conforms to the following regulations:

- Declaration of Helsinki: ethical principles for medical research involving human subjects [41],
- Data Protection Code, Polish Data Protection Authority [42],
- Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) [43],
- Resolution of Institutional Review Board of the University of Łódź.

Other information

Form of contact for those interested in cooperation with biobank

Information about collections, samples and data can be found in the catalogues described above. In order to get direct access to resources, please use the data below.

- e-mail: biobank@uni.lodz.pl,
- Phone number: +48 42 665 57 02,
- Corresponding person: Dr. Dominik Strapagiel, dominik.strapagiel@biol.uni.lodz.pl

External Biobank activity

Biobank Laboratory has a modern and very well-equipped laboratory, adapted to perform research in the field of genetics and molecular biology.

The unit cooperates with the public and private sector, offering services such as:

- DNA, RNA tests (DNA and RNA isolation from various biological materials),
- study of genetic variation using classical methods of molecular biology such as: PCR, real-time PCR, Sanger sequencing [18], high-resolution melting of PCR products (HRM) [3-4, 17, 21, 26, 44-45], Taq-Man probes,
- measurements of selected parameters of the tested material (fluorometric testing of the DNA concentration),
- separation of nucleic acids using horizontal, vertical, capillary electrophoresis,
- genomic DNA testing using microarrays (e.g. GWAS) [15-16, 20, 22-23],
- next generation sequencing (Illumina Platform, Nanopore Sequencing),
- gene expression testing (RNA-seq, microarray and qPCR) [46-51],
- epigenetic analysis (Chip-Seq, DNA methylation analysis, methylation RNA),
- microorganism genome analysis (de novo sequencing, variant calling) [44, 52-57],
- eukaryotes whole genome and targeting sequencing,
- aDNA analysis [58-59],
- human genome analysis (variant calling, NGS Target Enrichment, whole exome sequencing),
- amplicon sequencing,
- metagenomics and metabarcoding,
- bioinformatics analysis.

Biobank Laboratory applies an open data policy that allows broad access to data for interested researchers.

Biobank Laboratory conducts teaching and educational activities, engaging in numerous social projects for University of Łódź students and local community in Łódź.

Patent

- Method for identification of pathogenic fungi species contained in a sample taken from a patient – number P.408 734 [60],
- Method for determination of gender – number P. 406 569 [61]
- Method for determination of gender – number P. 423 420 [62],
- Method and a set for the detection of genetic predisposition to having a certain hair colour – number P. 403 360 [63].

Vision and plans for future

In the near future, Biobank Laboratory plans to expand its headquarters and acquire more highest class infrastructure for biobanking. Moreover, the unit plans to implement international standards related to management systems such as PN-EN ISO 9001:2015 Quality management systems – Requirements and PN-EN ISO/IEC 27001:2017 Information security management system – Requirements.

Major barrier

The main challenge for our unit is to recruit donors of biological material. Biobank Laboratory as a university unit is not a medical facility, creating difficulties in contact with potential donors. In addition, considering the population-based character of the biobank, Polish legislation lacks regulations regulating this area of biobanking.

Acknowledgments

The authors would like to thank Łukasz Pułaski for language editing, Jakub Lach and Justyna Jarczak for methodical supporting which improved the manuscript. This work was supported by Polish Ministry of Science and Higher Education - Project no. DIR/WK/2017/01

Conflict of interests

The authors declare no conflict of interest.

Table 1. Basic information about material stored in biobank

Collection name	Directory + ID number	Material type	Number of samples	Storage containers	Processing	Storage medium	Storage conditions	Corresponding person
POPULOUS	BBMRI-ERIC Directory 4.0, POPULOUS _BLUL	saliva	12000	Original Tubes from ORAGEN Kit DNAGenotek	N/A	Original preservative medium from ORAGEN Kit DNAGenotek	RT (18-25°C)	dominik.strapagiel@biol.uni.lodz.pl
POPULOUS	BBMRI-ERIC Directory 4.0, POPULOUS _BLUL	DNA	24000	MICRONIC	Automatic (MagnaPure LC 2.0, Roche); Etanol/ isopropanol precipitation	Elution Buffer (Roche), H_2O, TE buffer	-50 or -27°C	dominik.strapagiel@biol.uni.lodz.pl
BREAST	BBMRI-ERIC Directory 4.0, BREAST_CANCER_COLLECTION_BLUL	DNA	800	MICRONIC	Xylen extraction; Isolation Automatic (MagnaPure LC 2.0, Roche);	H_2O, TE buffer	-50 or -27°C	dominik.strapagiel@biol.uni.lodz.pl
BREAST	BBMRI-ERIC Directory 4.0, BREAST _CANCER _COLLECTION_BLUL	FFPE	800	Eppendorf tube	N/A	N/A	RT (18-25°C)	dominik.strapagiel@biol.uni.lodz.pl
PANC	BBMRI-ERIC Directory 4.0, PANCREATIC_ CANCER_ COLLECTION_BLUL	DNA	90	MICRONIC	Etanol /isopropanol precipitation	H_2O, TE buffer	-50 or -27°C	dominik.strapagiel@biol.uni.lodz.pl
PANC	BBMRI-ERIC Directory 4.0, PANCREATIC_ CANCER_COLLECTION_BLUL	Saliva	90	Original Tubes from ORAGEN Kit DNAGenotek	N/A	Original preservative medium from ORAGEN Kit DNAGenotek	RT (18-25°C)	dominik.strapagiel@biol.uni.lodz.pl
PUPILS	BBMRI-ERIC Directory 4.0, ANTHROPOLOGICAL_STUDY_ PUPILS_BLUL	DNA	961	MICRONIC	Etanol /isopropanol precipitation	H_2O	-50°C	aneta.sitek@biol.uni.lodz.pl
PUPILS	BBMRI-ERIC Directory 4.0, ANTHROPOLOGICAL_STUDY_ PUPILS_BLUL	Saliva	961	Original Tubes from ORAGEN Kit DNAGenotek	N/A	Original preservative medium from ORAGEN Kit DNAGenotek	RT (18-25°C)	aneta.sitek@biol.uni.lodz.pl
BREAST IBUL	N/A	DNA	250	MICRONIC	N/A	H_2O, TE buffer	-50 or -27°C	katarzyna.wozniak@biol.uni.lodz.pl

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