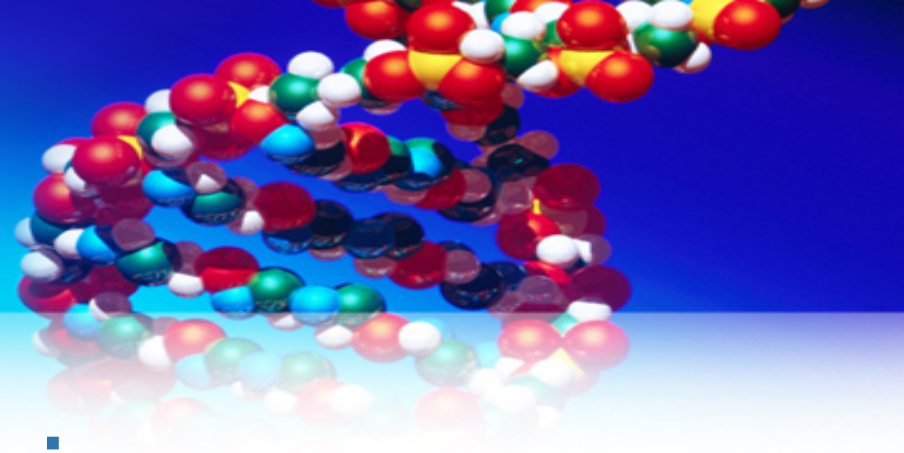


History of Biobanking (and ISBER)

Jim Vaught, Ph.D.
Editor-in-Chief
Biopreservation & Biobanking

Guest Professor:
Central South University, Changsha
Children's Hospital of Shanghai

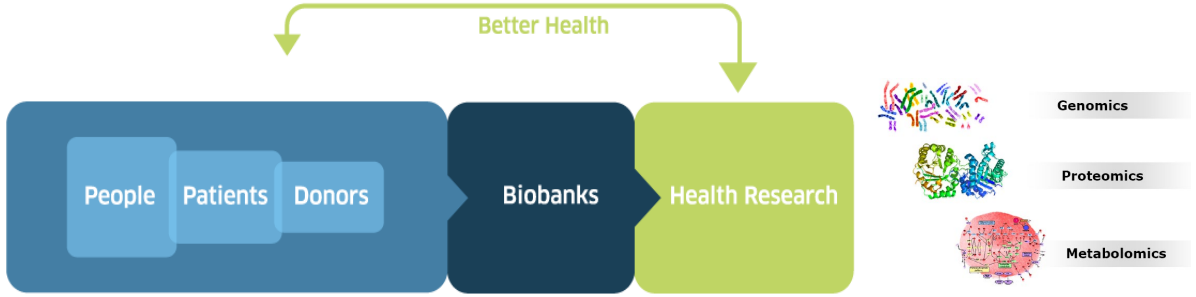
Jim Vaught has no significant financial interest or other relationship with the manufacturers of the products or providers of the services that will be discussed or could, in any way, influence the study to be presented.

What is a Biobank?

- An entity that receives, stores, processes, and/or disseminates specimens (blood, tissue, urine, saliva etc), as needed
- Encompasses the physical location as well as the full range of operational activities
- Can be one freezer or a free-standing entity, virtual, or part of an institution
- Has professional staff and a commitment to maintain and preserve specimens & records for future reference and historical continuity

Biobanks are the physical and organizational hub of an activity called biobanking, involving the collection of biospecimens and health information

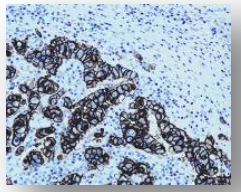
Importance:



Value:


science

industry


clinical

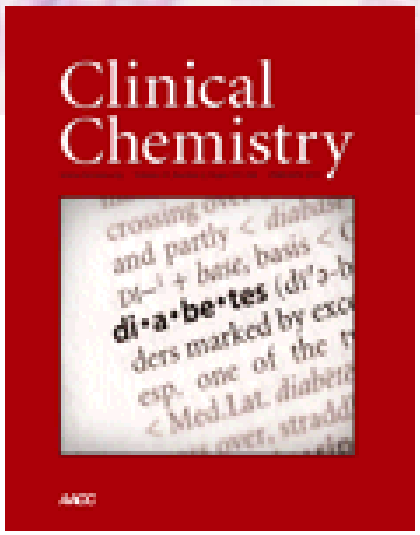
society

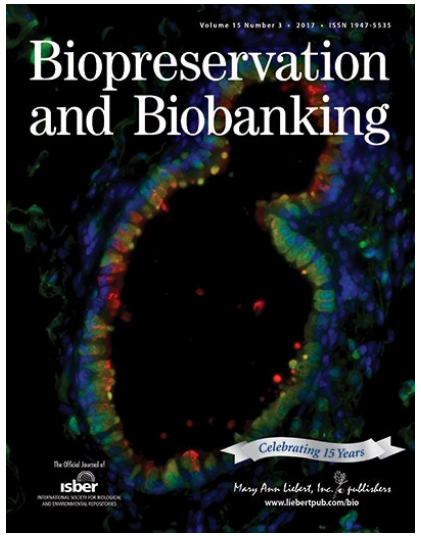

people

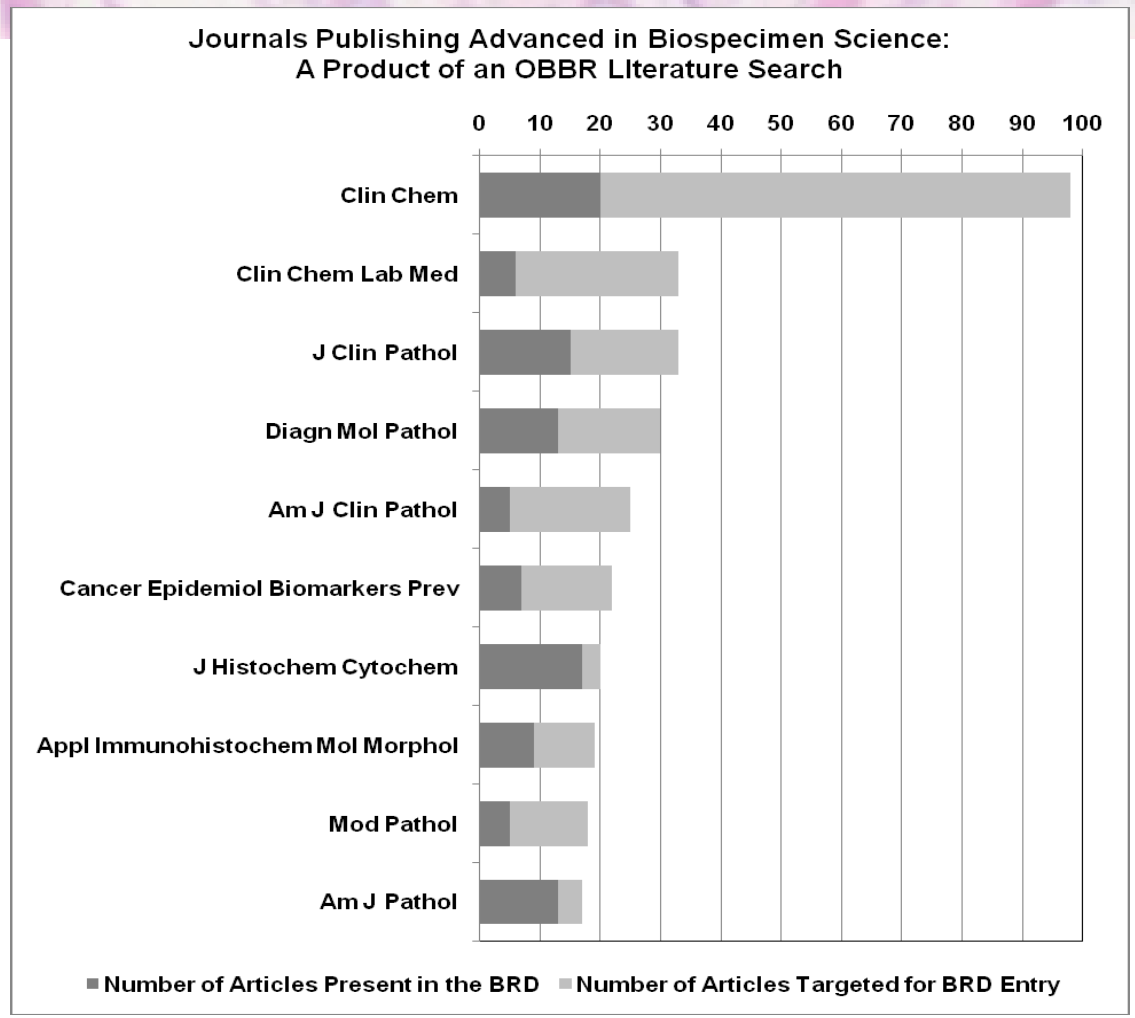
Biobanking is Multidisciplinary

- This presentation will concentrate on human biospecimens and biobanks
- Human biobanking can involve any of the following: pathologists, epidemiologists, clinical chemists, other clinical and basic, translational researchers
- Other than human biobanks, there are many types of biobanks and related collections: cell culture, museum collections, seed banks, collections from sea life for drug development etc.

Biobanking is covered by multiple journals







Early Biobanks

- Anatomy and pathology collections – diagnostic specimens and museum artifacts
- Armed Forces Institute of Pathology is one of the older collections in the U.S. – dating from the U.S. Civil War
- Later development: organized into biobanks and cataloged for research purposes
- Poor documentation, inventory control
- Little consideration of standard practices
- Variable quality – poor preservation technology

Biobanking Issues: Present

- Large biobanks with frozen samples, tissue, blood, saliva, dry blood spots etc
- Multiple biobanking best practices published over last 20 years: ISBER, US National Cancer Institute, International Agency for Research on Cancer & many more.
- Efforts to catalog and share information about samples and data
- Advanced information systems for tracking samples and managing clinical/research data
- Research into preanalytical variables
- Evidence-based practices; quality management programs
- Economics: Business planning and sustainability
- Next-generation biobanking: liquid biopsies
- Importance of biobanks for precision or personalized medicine.
- Automated freezers and biobanks
- Critical importance of ethical/regulatory issues & frequent changes, variations in national regulations.

Historical value of scientific collections:

US Government working group report shows importance of various types of collections on public health and other important issues.

Resources for medical breakthroughs

The National Center for Agricultural Utilization Research (NCAUR) in Peoria, Illinois – part of the USDA's Agricultural Research Service (ARS) – maintains a vitally important Culture Collection, which includes more than 150,000 yeasts, other fungi, and bacteria The collection, which was started in 1940, has been used to support cooperative research with the private sector to develop many beneficial medicines and food additives. In 1942, the production process could only generate enough penicillin to treat ten patients. Faced with the need for much larger supplies of antibiotics during World War II, the lab found a strain of *Penicillium* in the collection that increased the efficiency of the fermentation and production processes. By 1945, production had increased 25,000-fold, saving hundreds of thousands of lives by the end of the war.

Photo courtesy of the Research and Development Division, Schenly Laboratories Inc., Lawrenceburg, IN

Collections used in discovery of penicillin

The Oakland Municipal Auditorium in use as a temporary hospital during the 1918 flu epidemic.
Photo by Edward A. "Doc" Rogers, courtesy Oakland Public Library

Preventing and curbing pandemics

Researchers compared preserved samples of influenza virus taken from Smithsonian bird specimens with human tissue samples from the notorious 1918 Spanish flu pandemic to determine that the disease was not a type of avian influenza, as had been previously thought, but rather was related to strains that commonly infected pigs and humans. This discovery of the pandemic's true vectors has helped to guide the development of containment policy. Further studies of the virus's evolutionary history have helped improve vaccine development.

By studying the Smithsonian's mosquito collections, researchers are developing a better understanding of the vectors of rapidly emerging and potentially fatal diseases such as avian malaria and West Nile virus. Genetic analysis of rodent specimens was used to identify the presence and transmission of hantavirus in the early 1990s.

Image from clinic treating patients 1918 influenza pandemic. Samples used to study natural history of disease and develop vaccines

Smithsonian mosquito collections used to study emerging infectious diseases

Historical Value of Biospecimen Collections at US CDC

- **Legionnaire's Disease:** serum from > 30 unresolved pneumonia-like outbreaks stored in serum bank; identified a new organism and detected antibodies.
- **Hantavirus:** used residual serum and blood from a CDC nutrition study conducted in the same Navajo reservation area 2 years earlier; showed Hantavirus was not a new organism and was present in approximately 6% in the population before environmental conditions made the outbreak possible.
- **U.S. National Health & Nutrition Survey (NHANES):** excess and reserve specimens given to investigators after the original surveys were completed allowed greater research power and identification of new biomarkers.
- **HIV Collections:** traced emergence of new strains over time.
- **Hepatitis Strains:** used older NHANES collections to track the emergence of new strains over time in the U.S. population.

Slide courtesy of Elaine Gunter

Evolution of biobanking

Contents lists available at ScienceDirect

Clinical Biochemistry

journal homepage: www.elsevier.com/locate/clinbiochem

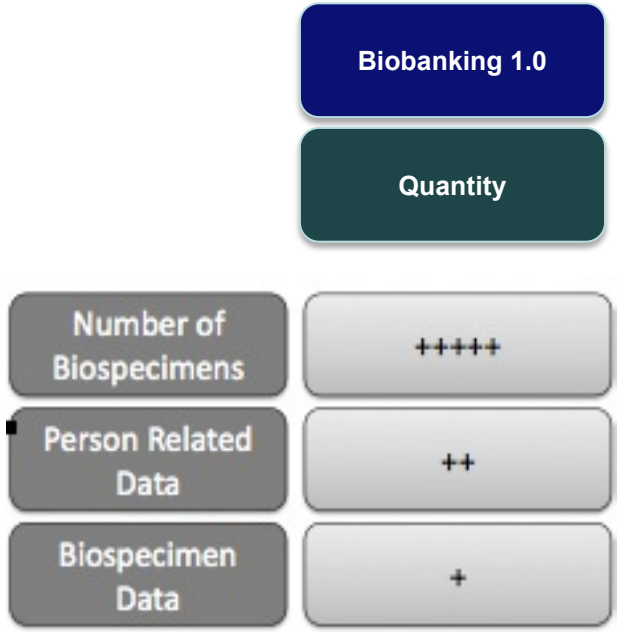
Biobanking 3.0: Evidence based and customer focused biobanking

Daniel Simeon-Dubach [a,*], Peter Watson [b,c]

Main Focus	Quantity	Quality	External Stakeholders
Number of Biospecimens	+++++	+++	++
Person Related Data	++	+++	++++
Biospecimen Data	+	+++++	+++++
Stakeholder's Needs	+	+	+++++
Sustainability	+	+	+++++

Evolution of biobanks

‘collections’



Modified from Simeon-Dubach & Watson Clin Biochem 2014

Biobanking – sustainability issues

‘Biobanks’

	Biobanking 1.0	Biobanking 2.0
	Quantity	Quality
Number of Biospecimens	+++++	+++
Person Related Data	++	+++
Biospecimen Data	+	+++++
Stakeholder’s Needs	+	+

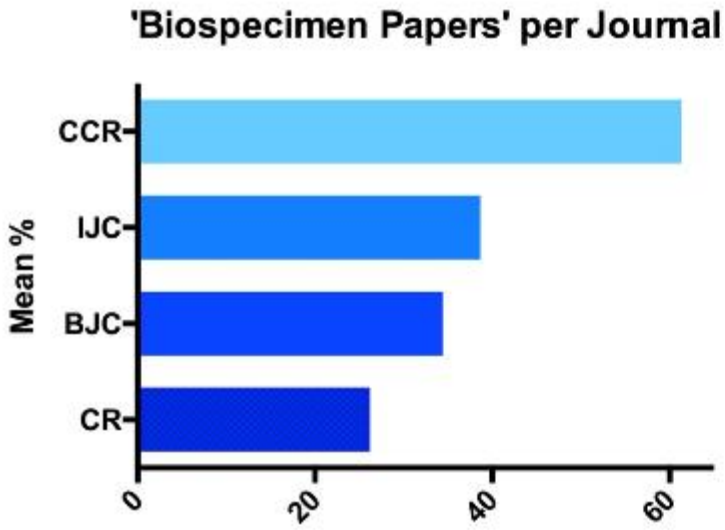
Modified from Simeon-Dubach & Watson Clin Biochem 2014

‘Biobanking’

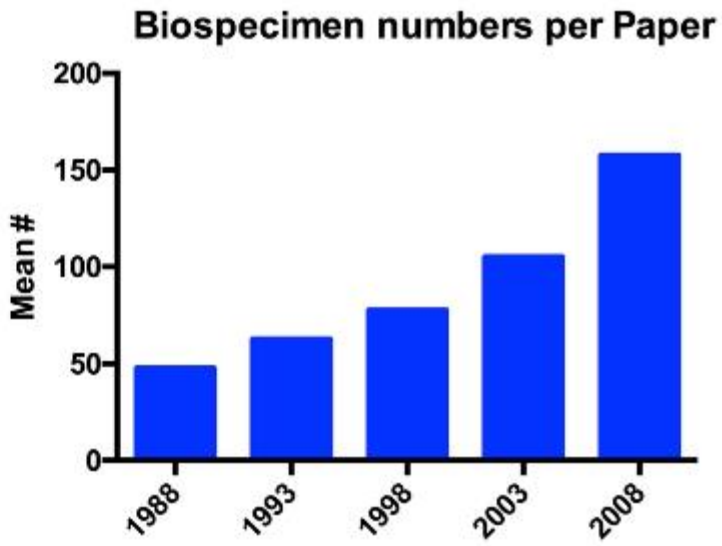
	Biobanking 1.0	Biobanking 2.0	Biobanking 3.0
	Quantity	Quality	Sustainability
Number of Biospecimens	+++++	+++	++
Person Related Data	++	+++	++++
Biospecimen Data	+	+++++	+++++
Stakeholder’s Needs	+	+	+++++

Modified from Simeon-Dubach & Watson Clin Biochem 2014

Biospecimens and cancer research:



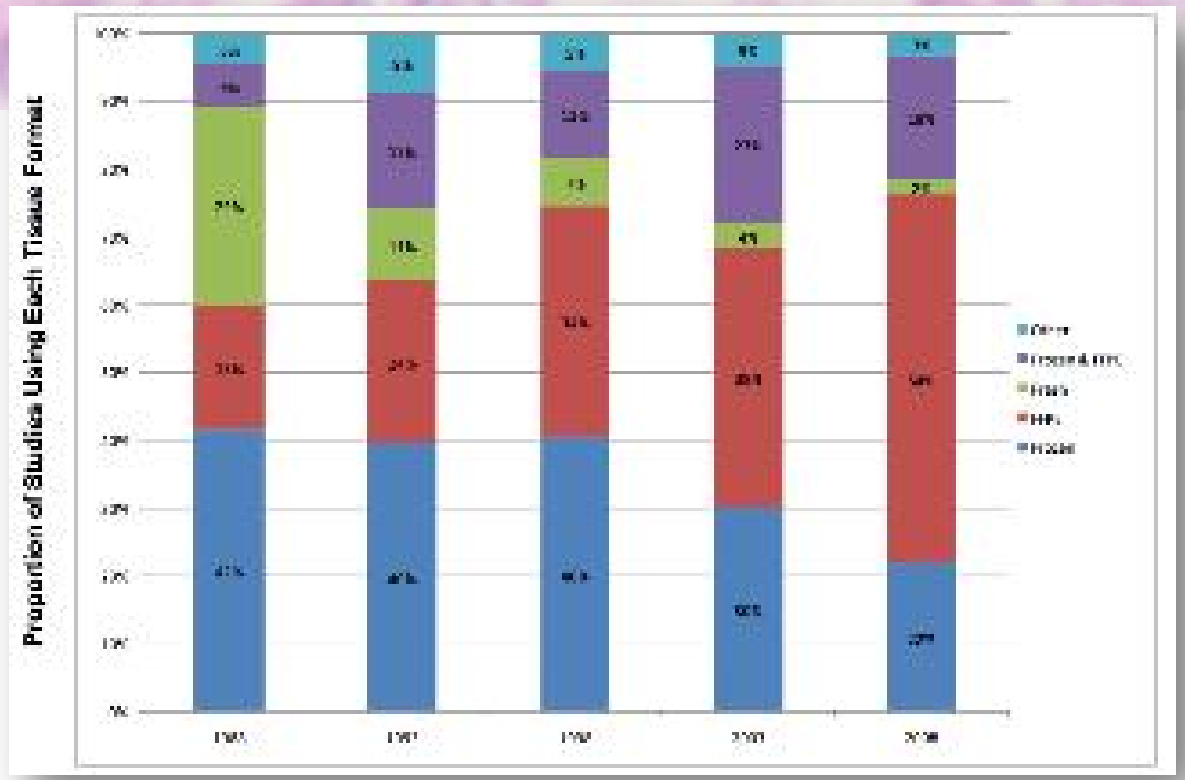
~ 40% of papers involve biospecimens



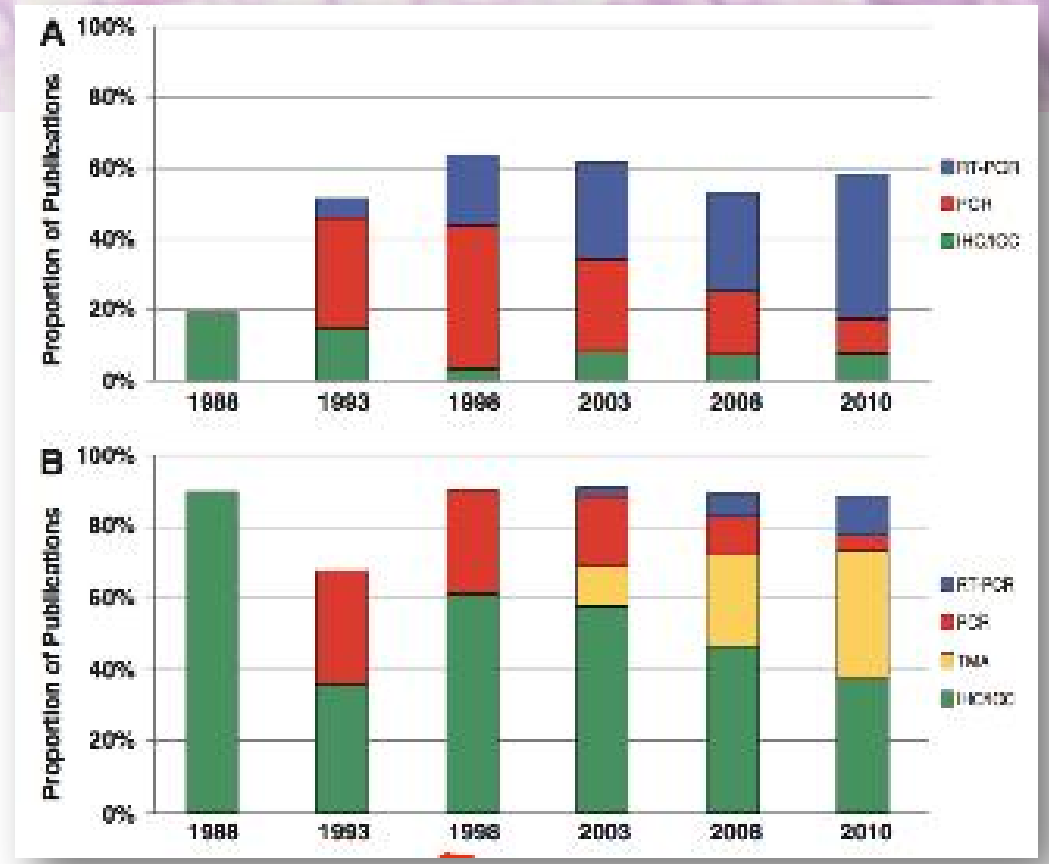
Biospecimen cohort sizes double every decade

Hughes et al Bio 2010; survey of x4 journals, over 20 years, > 3,000 papers':

Changing Biospecimen Needs over 30 Years



Increased use of FFPE (red),
decrease in fresh tissue (blue)



Frozen

FFPE

Mostly immunohistochemistry 30 years ago (green), increased PCR-based analyses (red), RT-PCR in frozen tissues, tissue microarrays from FFPE (yellow)

Hughes et al Bio 2010
Cole et al Bio 2012
Braun et al Bio 2014

Biospecimen quality: evolving needs

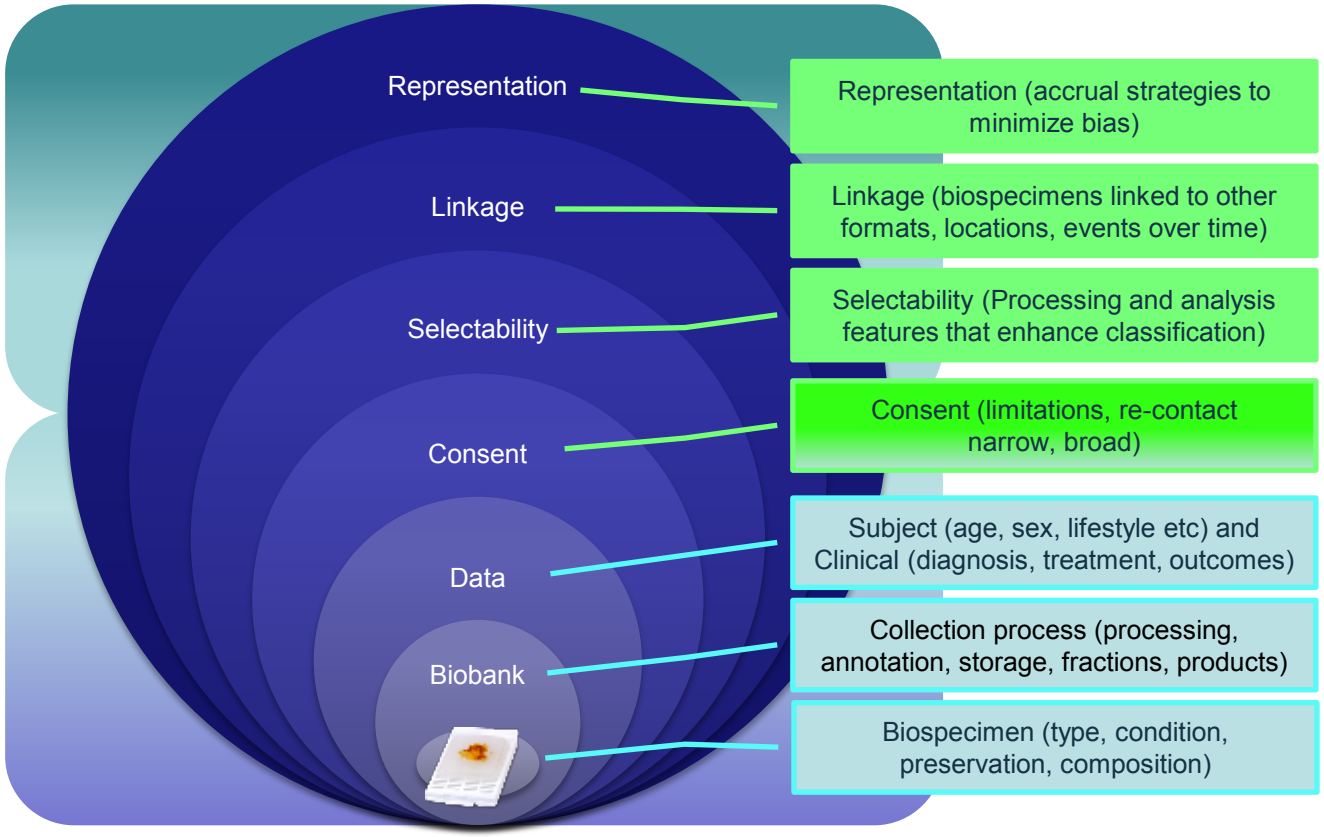
Facets of biospecimen quality

‘Complex’ features

Aspects of quality that are extrinsic to the biospecimen

‘Simple’ features

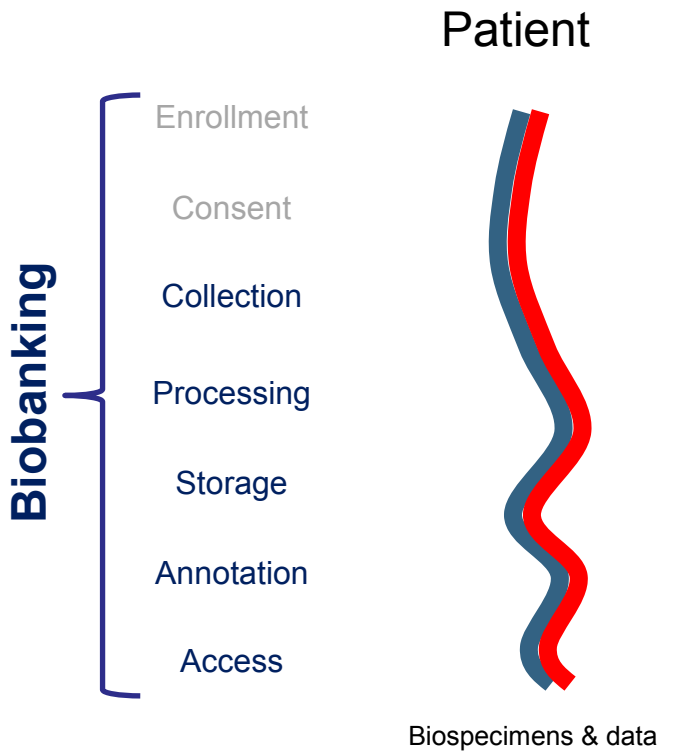
Aspects of quality that are intrinsic to the biospecimen



Research & Clinical Biobanking are closely related

1990 2000 2010

Single common process

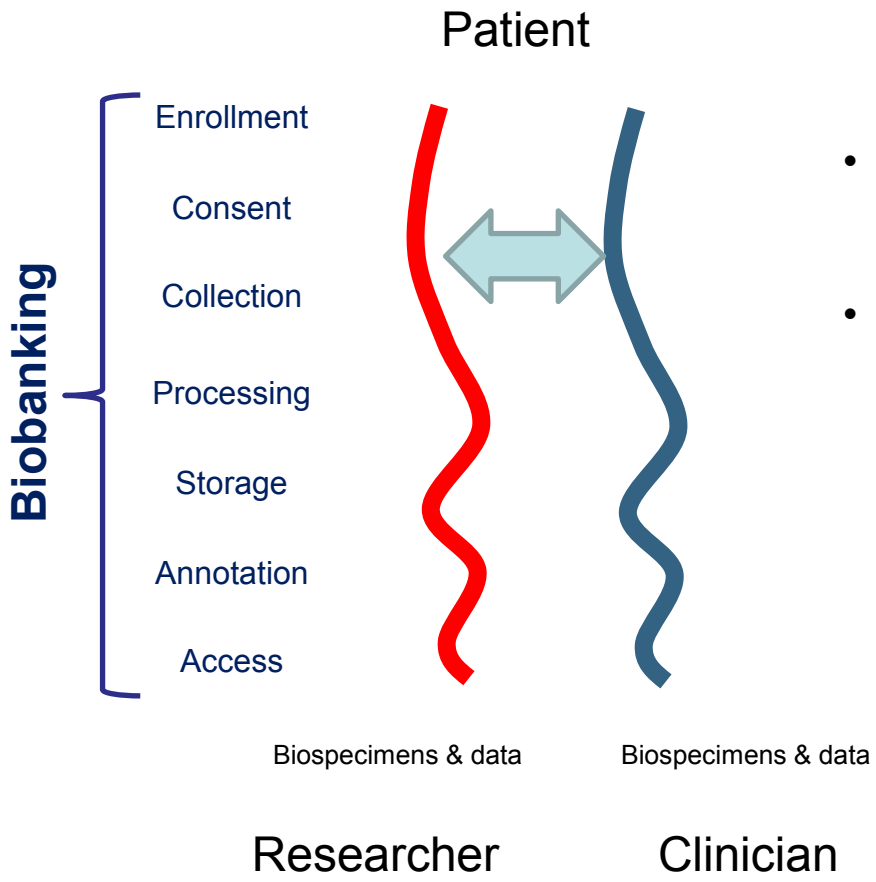


- Process was simple
- End uses were limited and similar
- Impact of quality unknown

Research & Clinical Biobanking are closely related

1990 2000 2010

Diverging processes

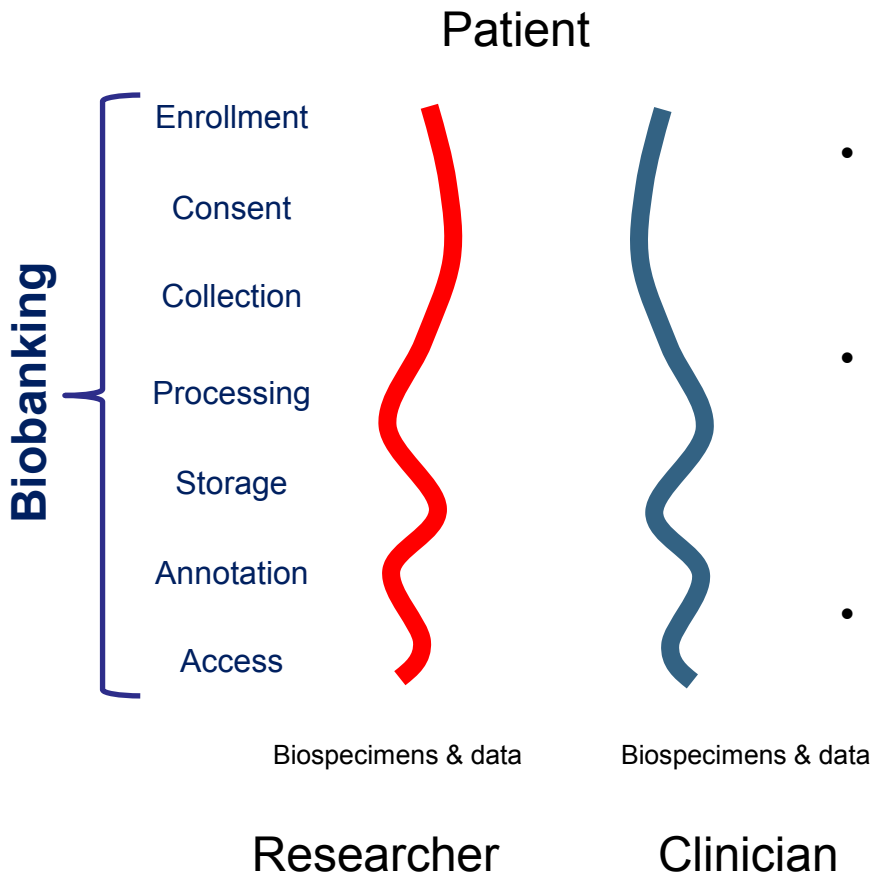


- Increased research demand
  - scale, formats, data,
- Increased complexity
  - research biobanking

Research & Clinical Biobanking are closely related

1990 2000 2010

Distinct processes



- Continued rise in research demand
  - scale, formats, data,
  - need for quality emerged
- Further complexity
  - discipline created
  - research biobanks developed
  - need for standards & education
- Absence of a biobanking strategy
  - Issues began to accumulate

Research & Clinical Biobanking are closely related

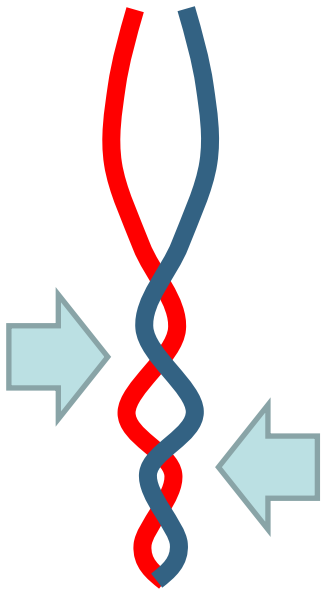
1990 2000 2010

Reintegrating processes

Biobanking

- Enrollment
- Consent
- Collection
- Processing
- Storage
- Annotation
- Access

Patient

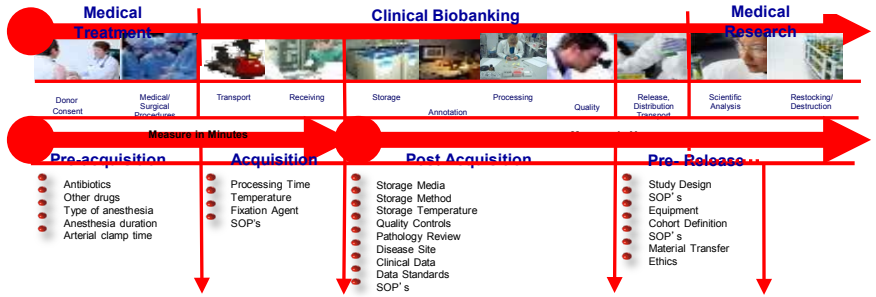


Biospecimens & data

Researcher

Clinician

- Research
  - investments maturing
  - Discovery, translation, & validation of biomarkers, targets, therapies
- Clinic
  - Changed importance of biomarkers
  - Incorporation of biospecimen science

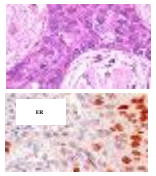


Breast Cancer

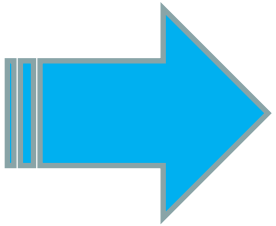
Diagnosis

Type
Grade
Stage

ER
PR



Therapy



Surgery
Radiation
Endocrinetherapy
Chemotherapy

Circa 2000

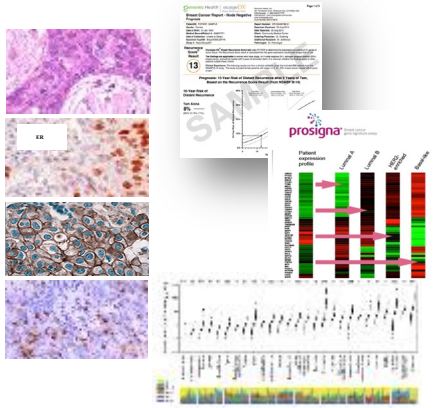
Breast Cancer

Diagnosis

Therapy

Type
Grade
Stage

ER
PR
Her2
Ki67
TIL



Surgery
Radiation
Endocrine therapy
Chemotherapy
Biologicals
Targeted therapies
Immunotherapy

Multigene biomarkers, targets, ‘omic profiles

Complex biobanking

Expanding therapies

Circa 2015

BIOPRESERVATION AND BIOBANKING
Volume 14, Number 1, 2016
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DOI: 10.1089/bio.2015.0019

BRIEF REPORTS

Trends in Biobanking: A Bibliometric Overview

Jonas J. Astrin[1] and Fay Batsou[2]

Biobanks have become indispensable tools for a wide array of life and environmental sciences, and biotechnology. To evaluate trends in biobanking, 20,000 bibliographic records were retrieved and analyzed between 1939 and 2014 from the Scopus database using a series of biobank-related search terms within titles and keywords. Since the 1990s, the field of biobanking has been, and still is, experiencing above-average growth in terms of publications, journals, and thematic orientations. Almost two-thirds of all indexed biobanking documents have been published in the last decade, with now >1,000 publications in 600 distinct journals per year. Around 50,000 individual authors can be identified who have so far contributed to the field of biobanking, with an average of 1.5 publications per author. Author affiliations follow an uneven distribution: 42% of the authors are based in Europe, 33% in North America, 13% in Asia, 5% in South America, 4% in Australasia, and 2% in Africa. Analyzing the most common title words revealed (as did the journals) a strong focus on blood banking, but other biospecimen types—especially seeds, cells, and tissues—have been gaining increasing weight recently. Among medical applications, *transfusion* dominates, followed by *transplantation*. While a noticeable increase in *disease* and especially *health* occurred at the beginning of the millennium, *cohort* and *consent* seem to have become high-relevance topics only in this decade. In terms of banked organisms, human dominates, followed by viruses and plants (especially represented through seed banking). A very rough estimate based on subject categories suggests that a third of all publications in biobanking focus on organisms other than humans. However, animal, fungal, and microbial biobanking are still underrepresented, especially when considering their shares in global biodiversity.

Introduction

BIOBANKING ENCOMPASSES THE "COLLECTION, preservation, storage and supply of biological samples and associated data, which follows standardized operating procedures and provides material for scientific and clinical use."[1] Biobanks—or biorepositories, molecular collections, biological specimen banks—are indispensable tools for a wide array of life and environmental sciences, biotechnology, and beyond.[2–15]

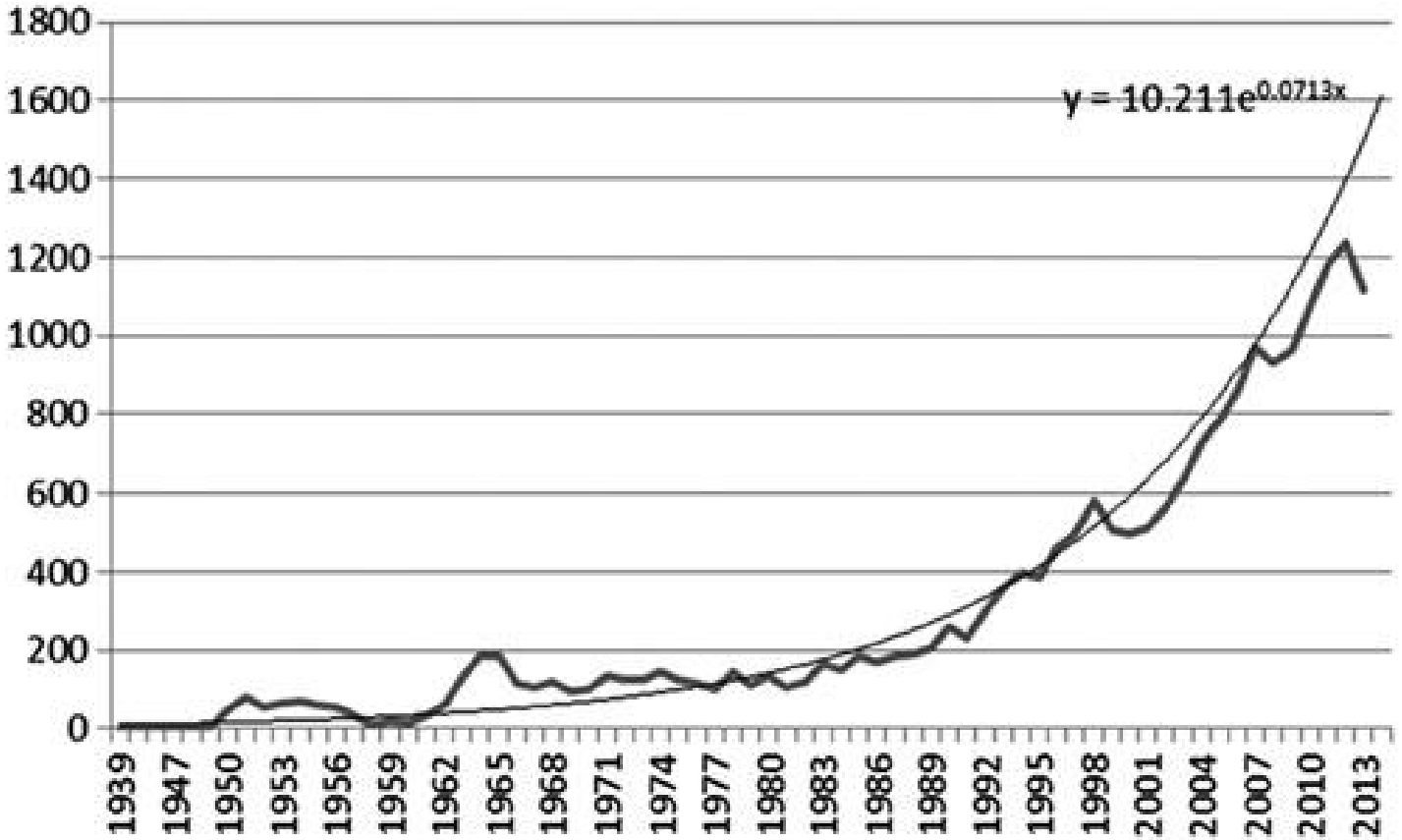
The purpose of the present study is to observe the development of biobanking using bibliometric tools and indicators. Bibliometrics applies quantitative methods to analyze academic publications as an information process, using the identified patterns and dynamics in scientific publication efforts as a proxy for the development of the analyzed discipline.[16–20]

For that purpose, the bibliographic database Scopus was queried, and >20,000 references to publications on biobanks were retrieved (represented through various general terms and special repository types in the search terms) since the beginning of coverage in bibliographic databases, that is, since 1939. The term "biobank research" has been used over the last years with various meanings. It has been used to signify (1) any research conducted with biobank-supplied biospecimens (research *with* the biospecimens), (2) biospecimen research (research *on* the biospecimens), and (3) research on biobanks (e.g., bioethics). It has also been used to signify high throughput research, most often linked to Next Generation Sequencing. The latter arguably constitutes a misuse of the word. To include as little research *with* biobank samples and rather to target research *on* biobanks or biospecimens, abstracts have not been considered while generating the data set of references. The retrieved data set was used to investigate, among other issues, the dynamics of annual publication numbers and involved journals, the geographic distribution of authors, and the use of relevant title words over time. The findings are offered to the biobanking community as an incentive to reflect on current trends in biobanking and biobank-connected publications.

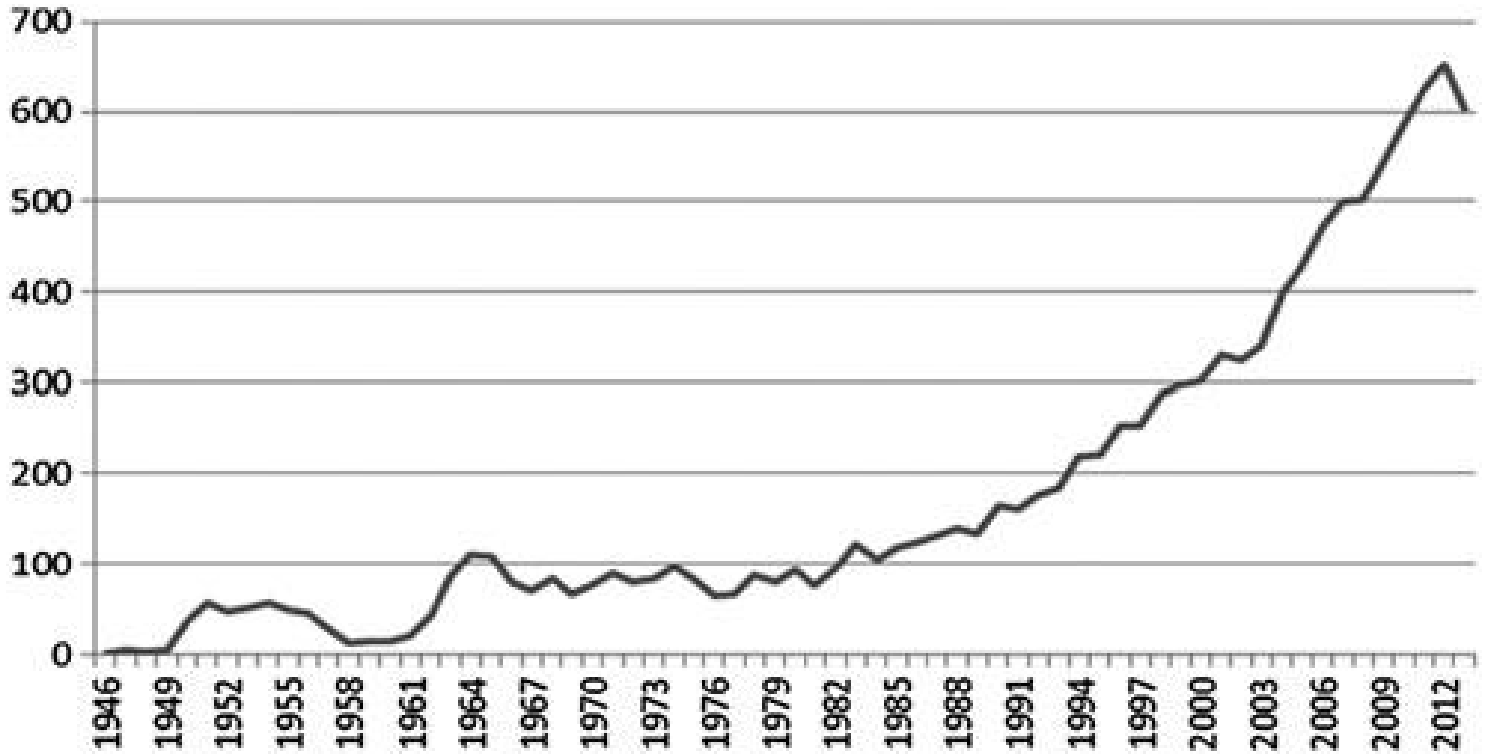
[1]Zoological Research Museum Alexander Koenig (ZFMK), Bonn, Germany.
[2]Integrated Biobank of Luxembourg (IBBL), Luxembourg, Luxembourg.

History of Biobanking from the perspective of publications history:
Explosive growth over 30 years

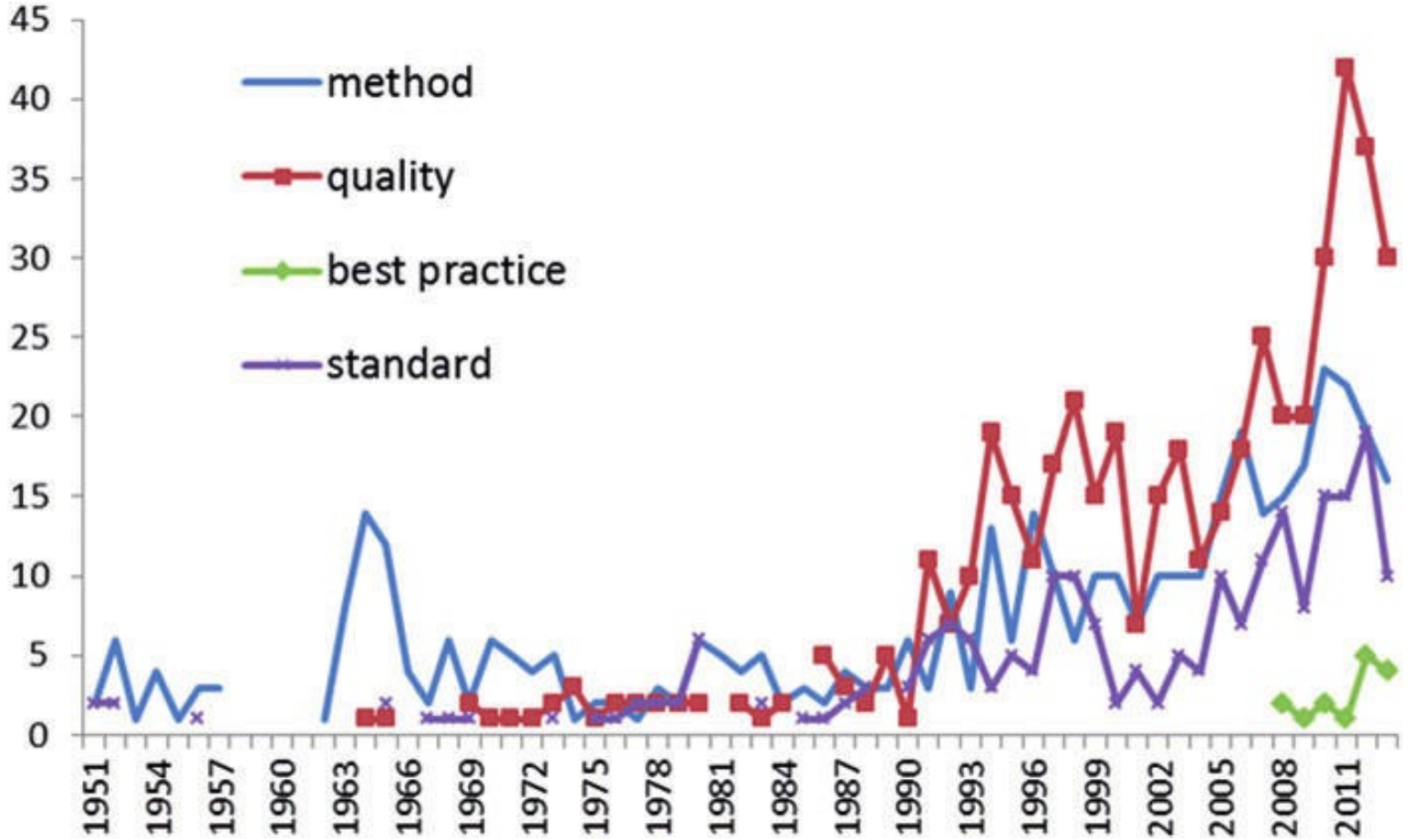
Biobanking related publications by year (see paper for search term details)



Annual number of journals publishing biobanking articles (as inferred from the search terms).



History of development of biobanking standards and practices



History of ISBER

1999
Initial
Planning
Mtg

2000
ISBER Chartered
Newsletter Launched
NCI Sponsored Mtg

2001
1st Annual Mtg in Atlanta
Website Launched

2005
ISBER a division
of ASIP

2008
1st Edition
ISBER Best Practices

2013
ISBER becomes
Independent Organization
Non-profit

2014
Regional Charter
Adopted

ISBER Goes Global – Regional Charter

- Objective: Construct Regional identity in a global Society

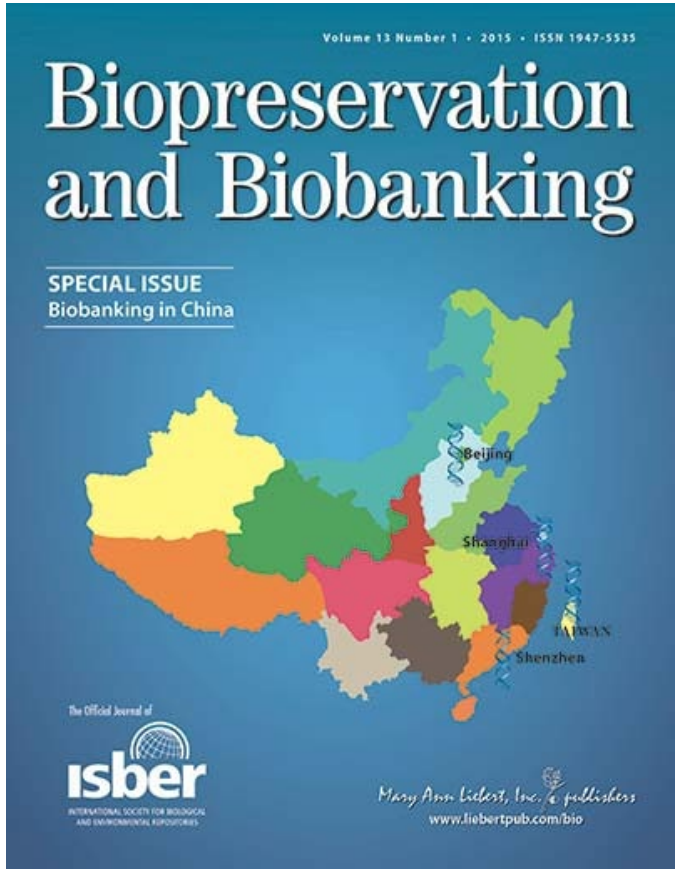
- 4 Regions
  - The Americas
  - Indo-Pacific Rim
  - China
  - Europe, Middle East and South Africa

Since 2001:

- Meetings in:
  - Boston
  - Bethesda
  - New York
  - Perugia, Italy
  - Singapore
  - Rotterdam
  - Sydney
  - Berlin
  - Toronto
  - Orlando
  - Phoenix
  - Dallas
  - Philadelphia
  - Seattle

- Shanghai!

History of Biobanking in China



BIOPRESERVATION AND BIOBANKING
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DOI: 10.1089/bio.2014.0096

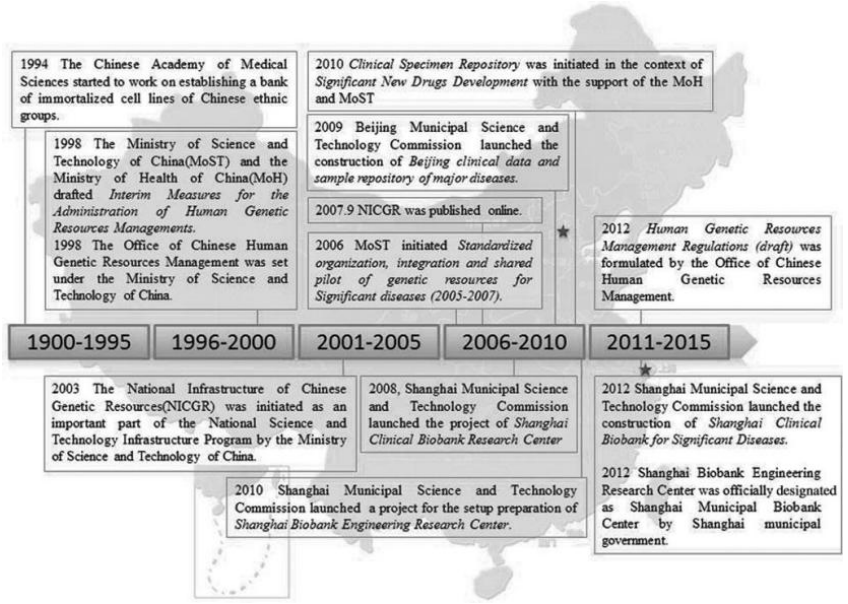
ORIGINAL ARTICLES

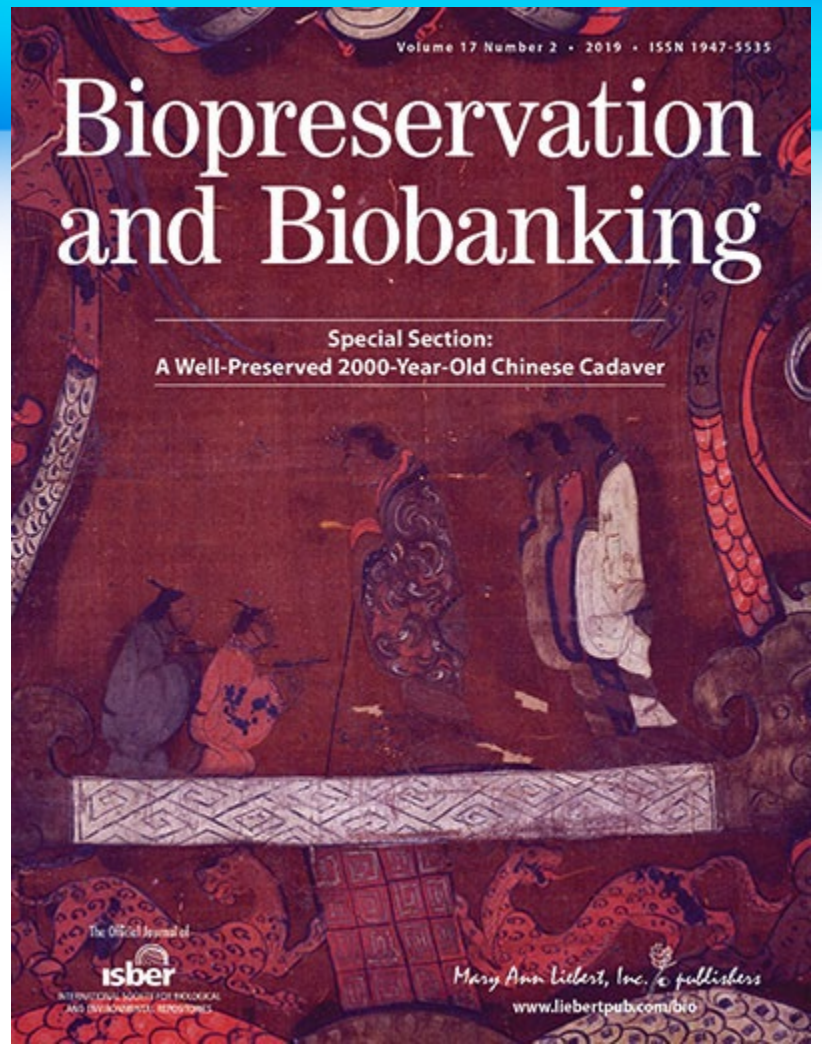
Chinese Biobanking Initiatives

Rongxing Gan,[1,3] Huiyuan Wang,[2] Yutong Song,[1] Jinli Fan,[1] and Yan Xiong[2]

Due to the requirement for comprehensive clinical research efforts in China, the importance of biobanking in modern clinical research is outlined in this overview. Hospitals, universities, and research institutes have been well organized as fundamental resources for Chinese biobanking initiatives and the resulting bio-sample collections. Here, a brief history and time line of development of biobanking in China will be introduced, as well as strategic designs for future biobanking development.

Chinese biobanking development from 1994

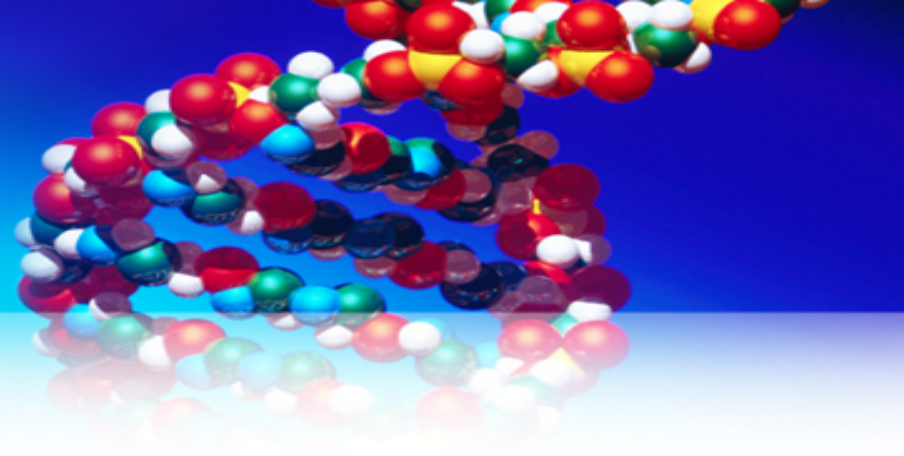




April 2019 Special Section:

A Well-Preserved 2000-Year Old Chinese Cadaver

isber
INTERNATIONAL SOCIETY FOR BIOLOGICAL AND ENVIRONMENTAL REPOSITORIES
Connecting Repositories Globally through Best Practices
leading since 1999



Thanks for your attention!

And thanks to Peter Watson and Elaine Gunter for their contributions of slides and ISBER history content.

jvaught44@gmail.com