Biospecimens and Biobanking in Global Health

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KEYWORDS

• Biobanks • Pathology • Data • Biospecimens • Tissue • Utilization • Catalogs • Information technology

KEY POINTS

- Biobanks or Biological Resource Centres provide critical infrastructure for clinical research and biomarker discovery when samples are well annotated with preanalytic data.
- Sample collections should be encouraged from geographically and genetically diverse regions to ensure relevant clinical health data for all populations, including those in low and middle-income countries.
- Biospecimen (tissue and biofluids) collection, processing, storing, and retrieval should be carried out with strict standard operating procedures (SOPs) to ensure sample quality and fit-for-purpose use.
- The SOPs should be developed that are appropriate for the available resources, without forfeiting the quality needed to result in meaningful molecular data.
- Documentation about samples, including preanalytic data, donor consent for use, and linkage to clinical data from the donor, should be kept in a robust laboratory information system to protect the data and ensure privacy and encourage ethical use of the samples and data.

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BACKGROUND AND INTRODUCTION

Infectious diseases continue to be a major burden of disease globally. According to the Global Burden of Disease Study 2015, although the epidemic of human immunodeficiency virus (HIV)/AIDS deaths peaked in 2005 and have annually decreased since 2015, with the scale-up of antiretroviral therapy (ART) and prevention mother to child transmission of HIV (PMTCT), particularly in Sub-Saharan Africa, there continues to be large-scale HIV/AIDS epidemics in many low and middle-income countries (LMICs).[1] Although life expectancy in many regions has risen due to the investments in interventions for infectious disease, many countries are seeing an increase in rates of noncommunicable disease burdens as their populations age. In fact, the global total of new cancer cases is projected to increase by 75% to 22.2 million annually by 2030, with an estimated 13.1 million deaths from cancer yearly. Approximately half of these cancer deaths will occur in low-income countries and more than 80% of these in African countries.[2,3]

It is crucial that appropriate interventions and infrastructure be implemented to confront this disease crisis. Biobanks play an important role in the study of infectious and noncommunicable disease etiology and identification of new potential diagnostic markers, and are central to the development of personalized drug treatment and translational research.[4–6] Investments in biobank infrastructure will enable scientific progress, on which effective disease control measures depend.

The aim of this article was to provide information on the collection, processing, and storage of biospecimens and the management of biobanks as a valuable tool for global health research in LMICs.[7] A biobank, defined as a facility for the long-term storage of biospecimens, is a key resource providing for access to high-quality human biospecimens. The combination of infrastructure, facilities, and resources is referred to as a biological resource centre (BRC). Tumor banks are BRCs; they have been defined by the Organisation for Economic Cooperation and Development (OECD) as service providers and repositories of living cells, of genomes of organisms, of cells and tissues, and of information relating to these materials.

Technological advances in molecular biology and genetics have greatly enhanced our ability to investigate the interactions among genetics, the environment, lifestyle, and health. Biobanks consisting of biospecimens from clinical and epidemiologic studies provide the opportunity to more effectively study disease causation and prognosis. At the present, analytical methods have developed to a level whereby they can be applied to large numbers of biospecimens, so biobanks play a cornerstone role in genetic and molecular epidemiology studies. The management of BRCs requires comprehensive quality management systems with appropriate controls. These are necessary to ensure that biospecimens collected for clinical or research purposes are of consistently high quality and are appropriate for the intended analyses and study goals.[8]

Despite advances in biobanking activities in high-income countries, populations in LMICs are underrepresented in sharing of these resources owing to their economic constraints and related issues. This means that studies are conducted without adequate representation of the populations that are mostly affected by the life-threatening diseases. Many research studies have been conducted in LMICs, but apart from the biobanks created in HIV treatment facilities for HIV research involving many individuals,[9–12] very few other research studies have found it necessary to establish a biobank, mainly because the sample sizes for many non-HIV studies are small, and the studies very rarely collect and store frozen plasma or DNA for further biochemical and genetic studies.[13]

When such biospecimens are collected, their collection and storage are not often planned or organized in any systematic way. Noting the absence of biobank studies