

## Biobanking of human orthopedic tissues

Severin Ruoss<sup>1</sup>, Dominic Baun<sup>1</sup>, Shannon N. Bremner<sup>1</sup>, Samuel R. Ward<sup>1</sup>  
<sup>1</sup>University of California San Diego, La Jolla, CA  
 severin.ruoss@gmail.com

**Disclosures:** The authors have nothing to disclose.

**INTRODUCTION:** Biobanking of human tissues is a balancing act between the collection of high-quality/high-value tissues, and their practical access and distribution along with associated meta data to a sample requestor vs. minimizing risks of physical harm during tissue collection, the inherent limitations of certain measurements or assays, protection of PHI (protected health information), and prevention of re-identification (managing risks to donors). Here, we present how we manage this balancing act using blanket IRB (institutional review board) protocols, a biobanking governing board, and multiple partially overlapping databases that are protected behind different firewalls.

**BODY:** Two major blanket IRB protocols were implemented: a remnant tissue and a biopsy protocol. The remnant tissue protocol covers collection of ANY remnant tissues yielded by ANY orthopedic procedure (thus the term “blanket”). “Remnant” means that the tissue is removed from the patient during a standard-of-care procedure and would be surgical waste tissue if not collected for the biobank. Accordingly, there is no tissue quantity limit to these collections. Examples for procedures and tissue types are 1), loose pieces of articular cartilage that are removed during internal fixation of tibial plateau fractures, 2), loose pieces of distal tibia that are removed during internal fixation of pilon fractures, or 3), tendon and muscle pieces that remain after ACL autografting procedures. Conversely, the biopsy protocol includes collection of tissues that would not otherwise be removed from the patient as standard-of-care. Here, the amount is restricted to 200 mg per biopsy and maximally 3 biopsies. With the exception of genome sequencing, the biobank allows broad use of downstream measurements or assays. However, in order to perform research on the collected samples, scientists (the tissue requestor) have to submit a sample request form to the bank which is evaluated by the bank’s governing board. Tissue requestors must provide research plans, IRB/ethics approval/determination, and declare any conflicts of interest. The board will then review requests to ensure all logistical, regulatory, and ethical requirements are met for approval. The requestor can download the sample request and utilized evaluation form on the biobanks’ website [https://humanperformance.ucsd.edu/?page\\_id=460](https://humanperformance.ucsd.edu/?page_id=460). The governing board can also be found on the website and is composed of internal and external scientists, clinicians, pediatricians, ethicists, lawyers, former athletes, regulatory personnel, and external advisors. The website also contains an interactive app that provides insight into currently available samples (Fig. 1, right). This serves as the publicly accessible, but least secured layer of information about banked tissues. Internally, we use Freezerworks to manage sample storage, i.e. to document de-identified samples, their location, and associated meta data, and to track their use (Fig. 1). Every subject and sample receive unique IDs in Freezerworks. The most secured layer is the medical history, which is entirely disconnected from the biobank and only used to identify candidates qualifying for sample collection and initial extraction of meta data (age at time of tissue collection, gender, height, body mass, comorbidities). We are using Redcap (Fig. 1, left) to bridge Freezerworks with the medical history, i.e., to link de-identified subject IDs with a medical record number. This makes our biobank data relatively secure as access to three individually protected platforms (medical record, RedCap, Freezerworks) is needed to re-identify de-identified research data.

Importantly, every sample is fractionated before storage to allow, 1), the same sample being utilized for multiple measurements and distributed to multiple requestors, and 2), to allow a variety of analyses including live cell work, histology, transcriptomics, and others. Finally, after sending samples to requestors, we are actively aiming at recapturing the generated data which enables us to connect data generated from the same sample and foster a collaborative research environment with the ultimate goal to further increase the value of the research output. As an example, we may obtain transcriptomics, proteomics, and histology data of the exact same sample, but from different initial sample requestors, and then correlate these datasets with medical magnetic resonance imaging data.

In summary (Fig. 1), we have multiple options available to recruit donors and collect tissue samples. They are then pre-processed and stored in a way that allows a broad range of downstream measurements. Through an easy online request form, scientists can request existing samples or discuss with us to target a specific sample type or cohort. Therefore, one of the goals of this biobank is to provide access to a variety of orthopedic tissues and, thanks to a streamlined workflow, to accelerate future research that may currently be considered gray phase.

## Data and Specimen Management Strategy

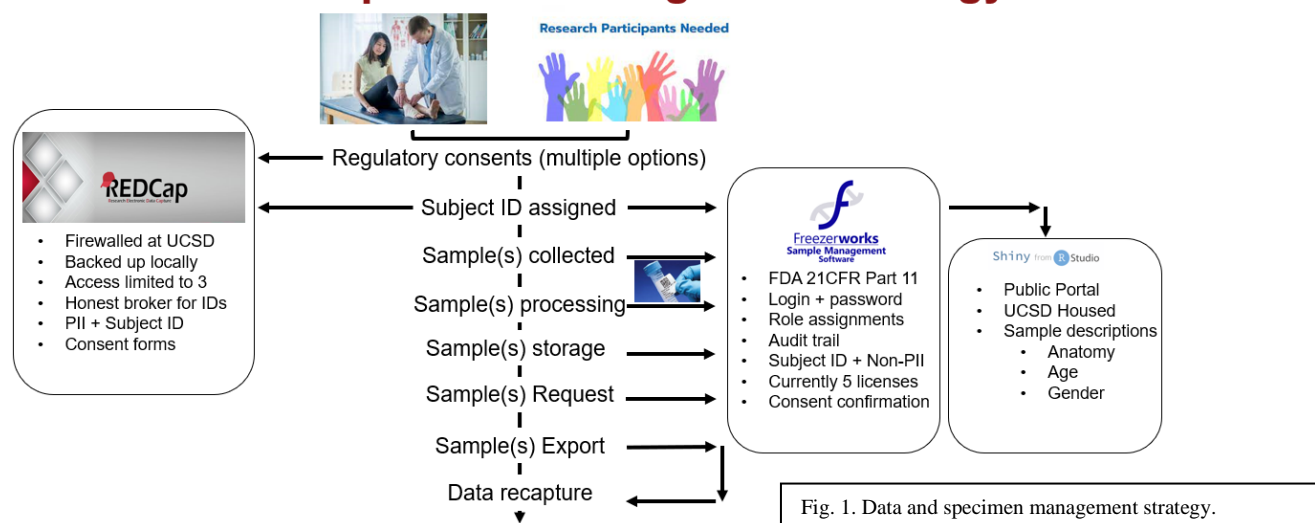


Fig. 1. Data and specimen management strategy.

**SIGNIFICANCE/CLINICAL RELEVANCE:** Our approach to centralization of tissues and a transparent, collaborative sharing hub has led to gained efficiencies through economies of scale, improved quality and reliability, limitation of liability, and the provision of quality patient care. The scope of today’s ‘omics-based research requires comparisons of data and results across multiple studies for replication and/or validation. A uniform approach at every level of a centralized repository from sample information systems to standards for procurement and storage is key to facilitate and optimize the use of resources in research.