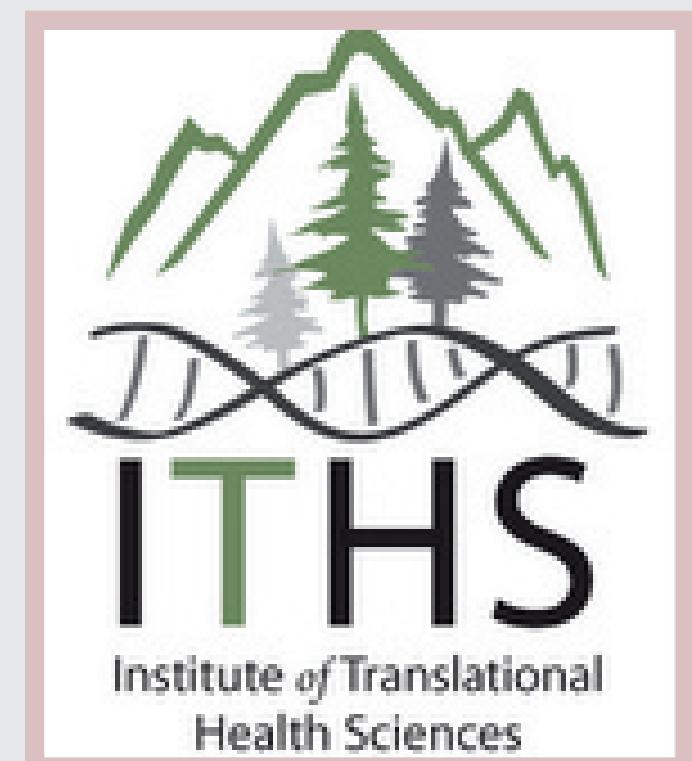


# RLab: A Lightweight Freezer Management System for Small Laboratories

Xenia Hertzenberg, BS<sup>1</sup>, Ronald Shaker, BS<sup>1</sup>, James F. Brinkley, MD, PhD<sup>1,2,3</sup>

<sup>1</sup>Departments of Biological Structure, <sup>2</sup>Computer Science and Engineering,

<sup>3</sup>Medical Education and Biomedical Informatics, University of Washington, Seattle, WA



This screenshot shows the main interface of the RLab web application. On the left, there's a sidebar with a tree-view navigation of subjects and samples under 'Family: SOC002'. The main area has tabs for 'LIST VIEW', 'SEARCH', 'MY CLIPBOARD', 'SEARCH RESULTS', and 'LAB NEWS'. Below these are buttons for 'NEW FAMILY' and 'NEW SUBJECT'. A 'QUICK SEARCH' bar with a dropdown for 'Family ID' and a 'Go!' button is present. The central part of the screen displays 'Aliquot Info' for a selected sample ('SOC002A-1-03/14/12-de-3'). It includes fields for 'Aliquot type' (set to 'PBMC'), 'Aliquot label', 'Box' (set to 'Z'), 'Row' (set to '1'), 'Col' (set to '3'), 'Cell Count' (set to '1.3 millions'), 'State' (set to 'NOT\_USED'), and 'Aliquot used by'. A context menu is open over the 'Aliquot used by' field, offering options like 'Mark As Used', 'Mark As Available', and 'Put on clipboard'. At the bottom, there's a copyright notice: 'Copyright 2009-2012 University of Washington'.

Figure 1. Main view: hierarchical display of "family" information

This screenshot shows a search interface for subjects. It includes dropdowns for 'Subject ID', 'Relationship', 'Sex', 'Other ID', 'Born', 'Date', and 'Disease'. Below these are buttons for 'Find' and 'Reset'. To the right, there's a 'QUICK SEARCH' bar with a dropdown for 'Family ID' and a 'Go!' button.

Figure 2a

This screenshot shows a quick search interface. It includes a 'QUICK SEARCH' bar with a dropdown for 'Family ID' and a 'Go!' button. Below it is a form for entering search criteria: 'Label' (set to 'SOC002A-1-03/14/12-de'), 'Type' (set to 'PBMC'), 'Status' (set to 'NOT\_USED'), and 'Cell Count' (set to '2.1 millions'). There are also dropdowns for 'Box', 'Row', 'Col', and a 'Comments' section with placeholder text about aliquot tracking.

Figure 2b

Figure 2c

Figure 2. Search options: a) search by subject, b) quick search, c) search by aliquot type

This screenshot shows a form for entering multiple aliquots. It includes a 'QUICK SEARCH' bar with a dropdown for 'Family ID' and a 'Go!' button. Below it is a table with columns for 'Label', 'Type', 'Status', 'Cell Count', 'Box', 'Row', 'Col', and 'Comments'. The table contains several rows of data, each representing an aliquot entry.

Figure 3. Enter multiple aliquots

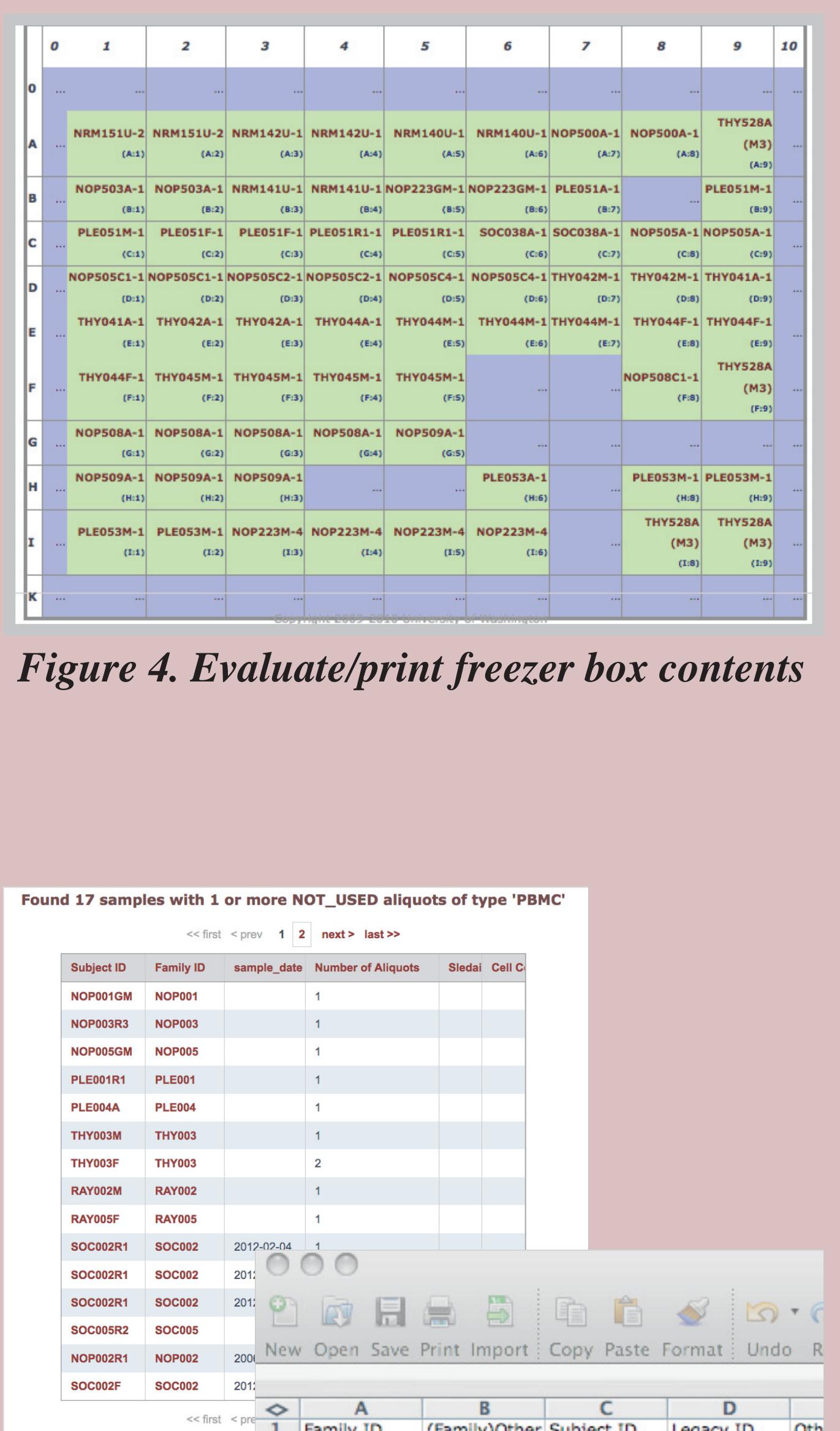


Figure 4. Evaluate/print freezer box contents

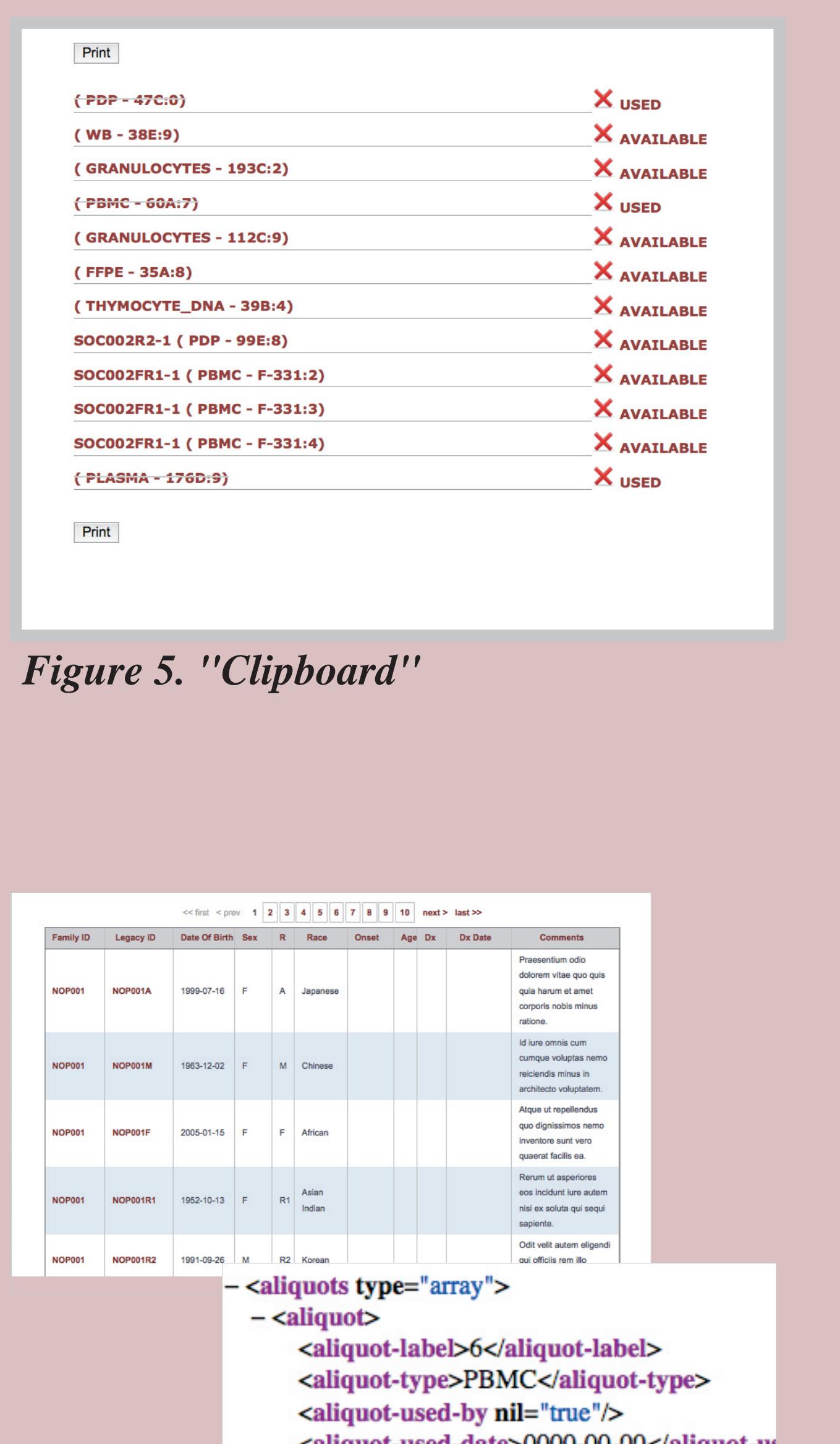


Figure 5. "Clipboard"

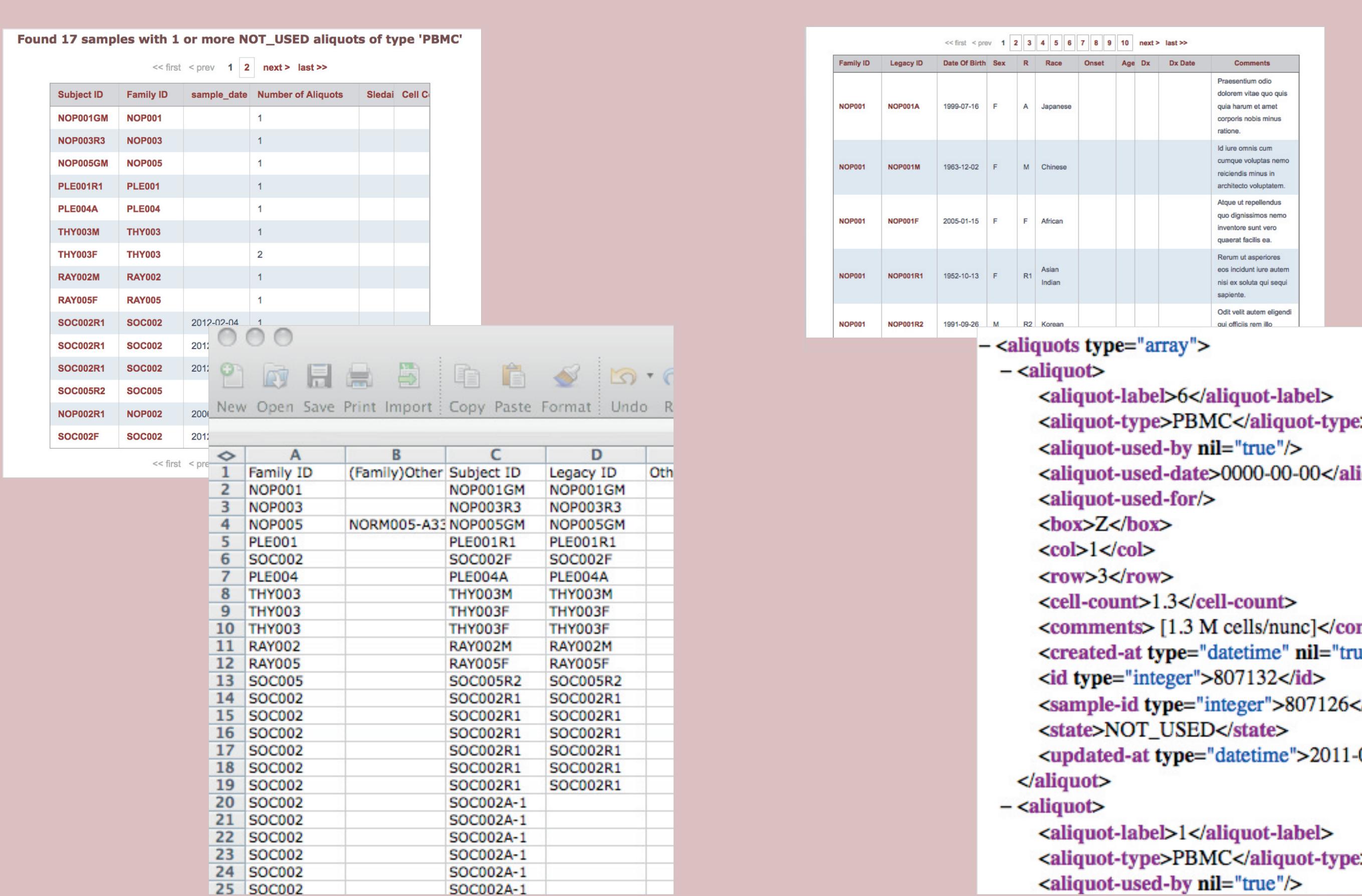


Figure 6. Export to spreadsheet

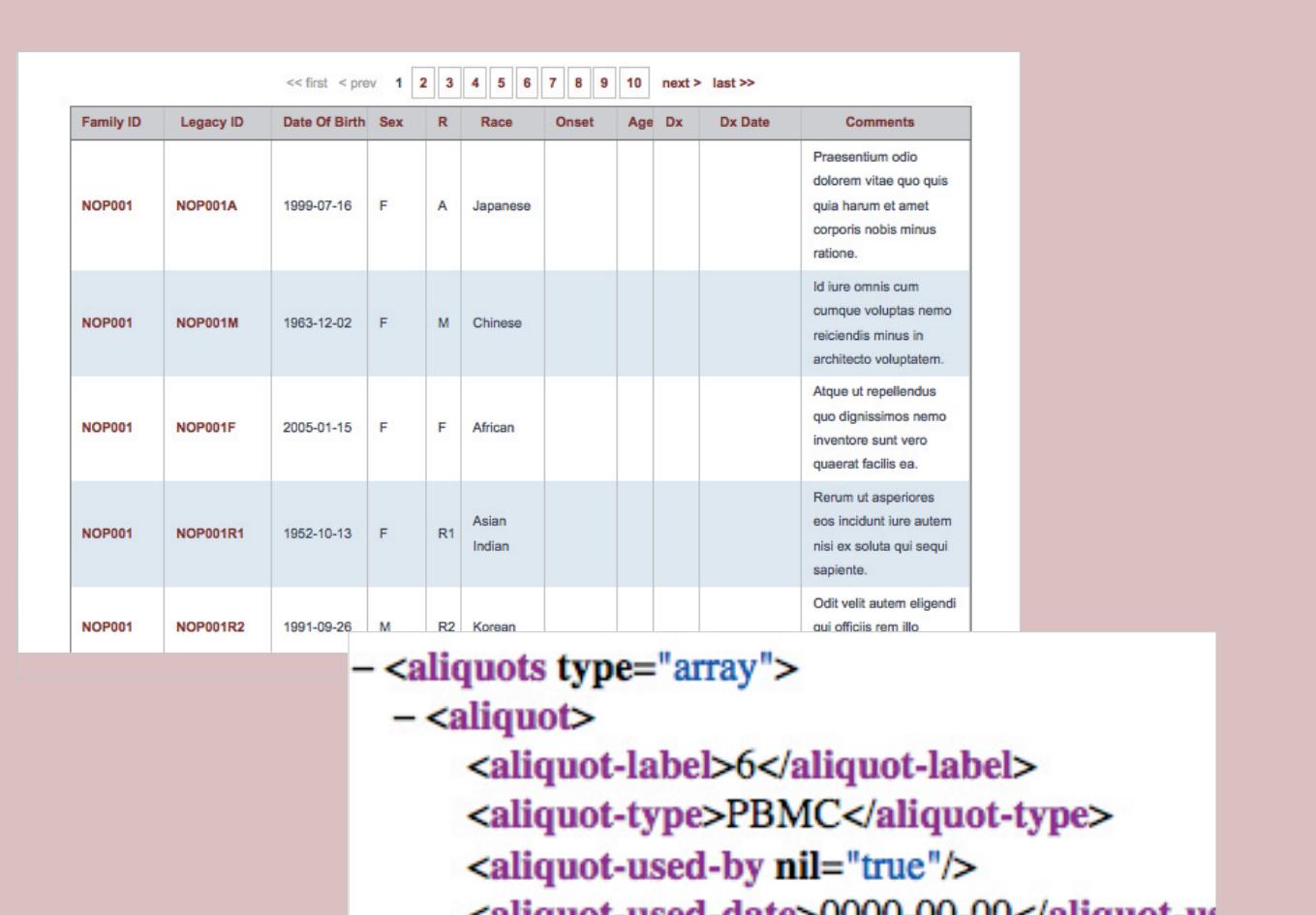


Figure 7. API provides XML output

## rLAB FREEZER MANAGEMENT WEB APPLICATION

RLab is a freezer management web application that can be deployed on multiple platforms. It utilizes Ruby on Rails framework, which allows for quick prototyping of user-requested features. rLab current set of features includes ability to view the hierarchy of entities, quickly search for subjects, run specialized queries for aliquots satisfying specific criteria, and easy data entry, including ability to enter multiple aliquots at once. To support auditing tasks, RLab's freezer visualization feature allows technicians to print box contents.

One of RLab's most useful features is its "clipboard" mechanism, which allows users to generate and store lists of aliquots satisfying particular search criteria. Recognizing that spreadsheets are useful for reporting and analyzing data, we provide export facilities that give users access to their inventory data in CSV format. Finally, we've equipped our freezer management tool with a simple, RESTful API for extracting inventory data in XML format.

## INTRODUCTION

In small laboratories, technicians frequently use spreadsheets to log the type and location of biospecimens. Even for studies with a small number of subjects, the use of spreadsheets can lead to complex workflows. For example, maintaining a master version of each document is required to avoid conflicting updates. Restricting document access in order to protect patient privacy requires planning and oversight. Validation of spreadsheet fields is needed to ensure data integrity. Some of the currently available freezer management systems address security, accessibility and validation (i.e., Freezerworks, CAISIS, caTissue), but expensive licensing, difficult learning curves, and complex administration often make existing solutions inaccessible to small laboratories with limited budgets.

## HISTORY AND REQUIREMENTS

Our goal is to help small laboratories migrate away from using spreadsheets for managing their inventories, and to introduce them to scalable web-based solutions. We proposed building a lightweight tool with the following requirements:

- tool can be easily installed and administered by individual researchers.
- tool provides a web-based interface for accessing to freezer inventory
- tool's scope is kept narrow and focused on basic freezer management tasks
- tool needs to provide an externally queryable API to facilitate export and integration of freezer data with data from other systems.

To address the hurdle of licensing fees, we chose to release our freezer management tool as open source.

Our first attempt to build a freezer management system for use by small laboratories resulted in creation of the Customizable Electronic Laboratory Online<sup>1</sup> (CELO) framework. An instance of CELO was deployed to a small laboratory at the Seattle Children's Research Institute (CRI). Users at CRI found CELO's interface less user-friendly and harder to navigate than the spreadsheets they previously employed. Based on user feedback obtained during the CRI pilot, we have designed a new freezer management system called RLab. RLab's feature set (current state of which is presented in Figures 1-7) continues to evolve through close observation of CRI's workflow.

## CONCLUSION

RLab is an affordable, easy to use alternative to commercial freezer management products. It allows multiple users access to freezer inventory data without versioning concerns and provides for both data validation and integrity checks. The application's query API makes it easy to integrate freezer data with that of other laboratory systems, providing the ability to ask queries across all of a study's data.

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## REFERENCES

Fong, Christine and Brinkley, James F (2006) Customizable Electronic Laboratory Online (CELO): a web-based data management system builder for biomedical research laboratories. In Proceedings, American Medical Informatics Association Fall Symposium, Bethesda, MD.