SIMS: Samples Inventory Management System

Version: 1.3.0

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1 System Overview

The Samples Inventory Management System (SIMS) is a Web-based platform for managing the life cycle of biological samples, mainly urine and blood, collected as part of multiple clinical studies in the field of nephrology. In our network of collaborating institutions, personnel collect samples, store them in freezers, and deliver them to other laboratories as needed. We designed SIMS to track and monitor this multifaceted process. The system supports multiple simultaneous users and provides the functionality to manage the following data categories.

1.1 Data Categories

- **Studies**: Samples are organized within studies or protocols. Each study undergoes several phases: the design phase when studies are created and their protocols (study sites, timepoints, and sample types) defined, the submission and approval phase, and the collection phase when patients are recruited and samples stored. Once the collection phase is over, the existing samples are analyzed until they have been exhausted.
    - **Study sites**: Each study has own or more individual sites.
    - **Timepoints**: Study timepoints denote when samples were collected. ex) baseline (pre-operative), Day 1, Day 3, etc.
        - **Samples**: Various properties of the biological samples (sample type, number of aliquots, quantity uL)
- **Patients**: Each patient listed in the system is part of one discrete study. Patient IDs (e.g.: CAR-01-0001) are automatically generated in SIMS by combining the two or three digit study ID and a hyphen, the two-digit study site ID, and a four-digits sequential auto-generated number. The same physical patient may be in more than one study, but this relationship is not stored in the system. Instead, an external system will be needed to track that relation between the SIDS study patient IDs and real patient identifiers. Thus, there is no PHI stored in SIMS.
- **Samples**: Upon creation of patient IDs, the system auto-generates sample-entry records for each protocol portion that is available for that patient (patient_id, timepoint, sampletype, status, status date, freezer location, shipping location, etc.) Depending on its destination, each sample will display a status (filled, consumed, shipped, etc.)
- **Freezers**: Samples are stored in freezers. The space in the freezers is subdivided into shelves, racks, and slots. A single slot is also referred to as a “freezer location” which can contain a box.
    - **Freezer locations**: Each box uses a coordinate system of Rows (A-J) and Columns (1-10). Additionally, each box contains samples from only one study.
- **Shipments**: SIDS also tracks shipments of samples to external collaborators and marks which samples have been shipped out. SIDS tracks dates, destination information, carriers, and tracking numbers. Each shipment is bound to a specific study and can consist of one or more boxes. Additionally, the specific location of each sample is recorded in the boxes, allowing a manifest to be generated and included with the shipment.

1.2 System Security

SIMS has a range of functionalities, which are allotted to different levels of users based on their need or lack thereof of certain information and capabilities. The functions from lower privilege users are always available to higher privilege users as well. The capabilities of users from low to high privilege are as follows:

- **Navigator**
  - Browse only. No changes can be made to the underlying data.
  - Generate reports.

- **Data Collector**
  - Collect samples for specified studies and scan into freezer locations.
  - Ship sample boxes for specified studies.

- **Study Administrator**
  - Create new studies.
  - Define study protocols (e.g. study sites, timepoints, timepoint samples).
  - Change study status.
  - Define patients and create sample barcodes.
  - Create shipping entries, change shipping status.

- **System Administrator**
  - User management: Generate users. Assign user roles.
  - Maintain shipping locations.
  - Create and edit freezer information.
  - Maintain general list of sample types used by the system.

1.3 Navigation / System Interaction

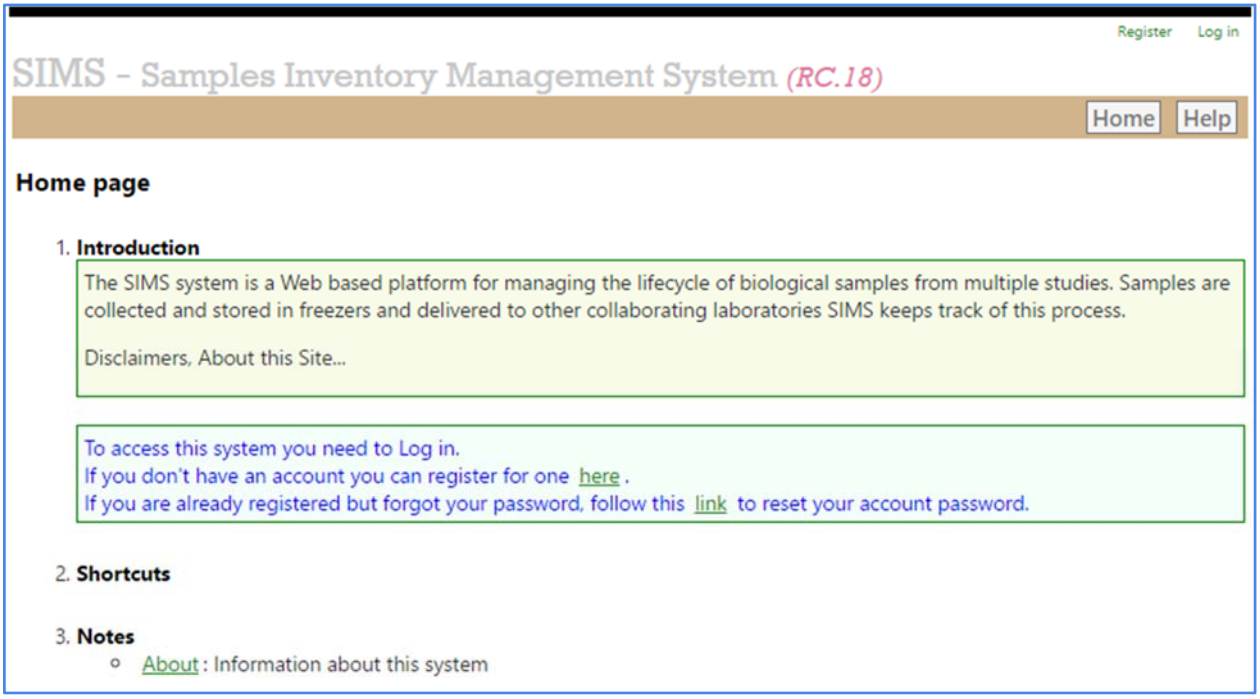
This section describes how to execute specific tasks in the system. These include connecting to the system, logging in, navigation, and management of the data categories supported by the system.

1.3.1 Account Creation and Home Page

Users must create an account to interact with the SIMS system. If you do not have an account, go to “Log in” on the far top-right, and select, “Don’t have an account”. Enter an email address and password. You will receive a confirmation link. You must be in the Yale network to be able to access SIDS.

Once you have your account, you must contact the system administrator for assigning your rights to access the system.

Note: the system will automatically log out users following periods of inactivity. If you encounter a page saying that you do not have rights to access the system, try to log out and log back in.



The main menu bar is populated with options to interact with studies, shipments, freezers, reports, configuration, and a link to help pages. General information about the system is displayed on the home page.

1.3.2 Main Menu

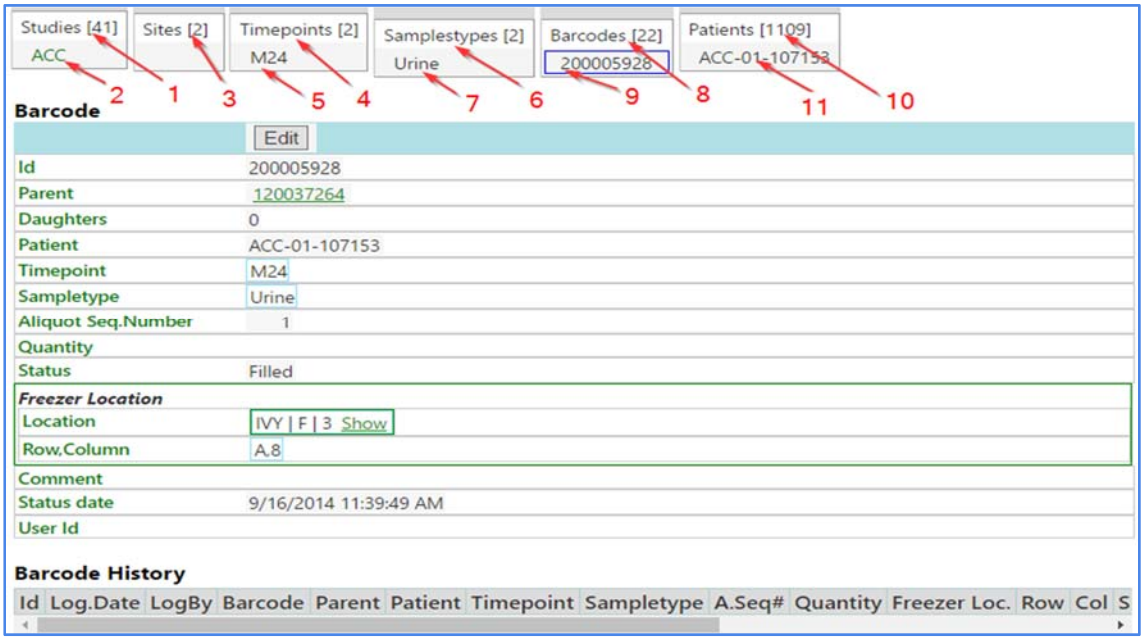
The main menu is a tan-colored bar which allows quick access to functionalities within the system. This menu is presented below in two forms. Before:

and after a successful log-in:

1.3.3 Hierarchical BreadCrumbs Menus

When certain options (e.g. studies, shipments, and freezers) are selected, a hierarchical breadcrumbs menu is displayed just below the main menu. This menu informs the user of where exactly in the interaction with the system they are. It provides two layers: a top layer indicating a data class and a lower layer for a specific element within that class.

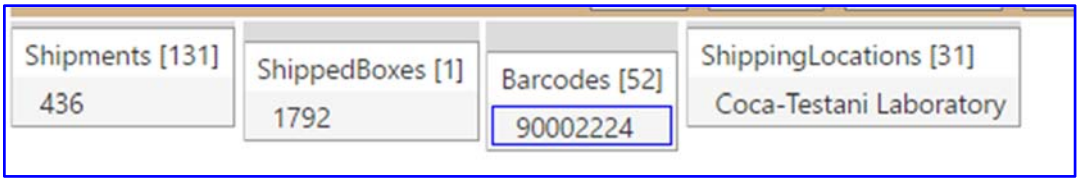
The following image shows a study's breadcrumb menu populated for a specific sample. On the page shown below, the user can easily jump with a single click to the studies (1), study details (ACC) (2), study sites (3), study timepoints (4), a specific study time point (5), samplestypes (6), a specific sample type (7), barcodes (8), a specific barcode (9), study patients (10), or a specific patient (11). The number enclosed in square brackets indicates the elements for the category, and a blue box is used to indicate the information selected and in display on the page (9).
Note that this menu displays boxes at varying **height-levels**. If a subsequent box is at a lower height than a previous one, that means that the information in the lower box is dependent upon the information in the higher box. For example, in the figure below Sampletypes [2] and Barcodes [22] are positioned below the box "Timepoints [2] / M24" indicating they are related to the Timepoint M24.



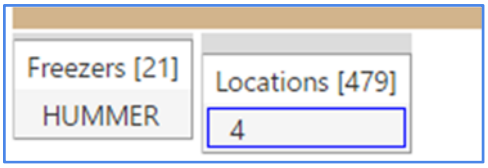
From the image above, we can tell that information is being displayed about patient barcode “2000005928” out of 22 barcodes, that are of sample type “Urine” (out of 2 possible sample types). This barcode is part of timepoint “M24” out of 2 timepoints, 2 possible sites, and study “ACC” out of 41 possible studies.

Note: Clicking on any of the boxes in the menu (ex. “Studies” or “Patients”) will bring you to a list of all the elements in that set. To see the other barcodes that belong to this patient (ACC-1-107513), click on the patient ID or “Barcodes [22].”

The shipments breadcrumbs menu below shows a specific barcode in the box. Note below that the selected barcode “90002224” is one of 52 barcodes in the shipped box 1792, and a total of 1 shipped boxes is part of Shipment 436. That shipment has shipping location “Coca-Testani Laboratory”, one of 31 Shipping Locations in the system.

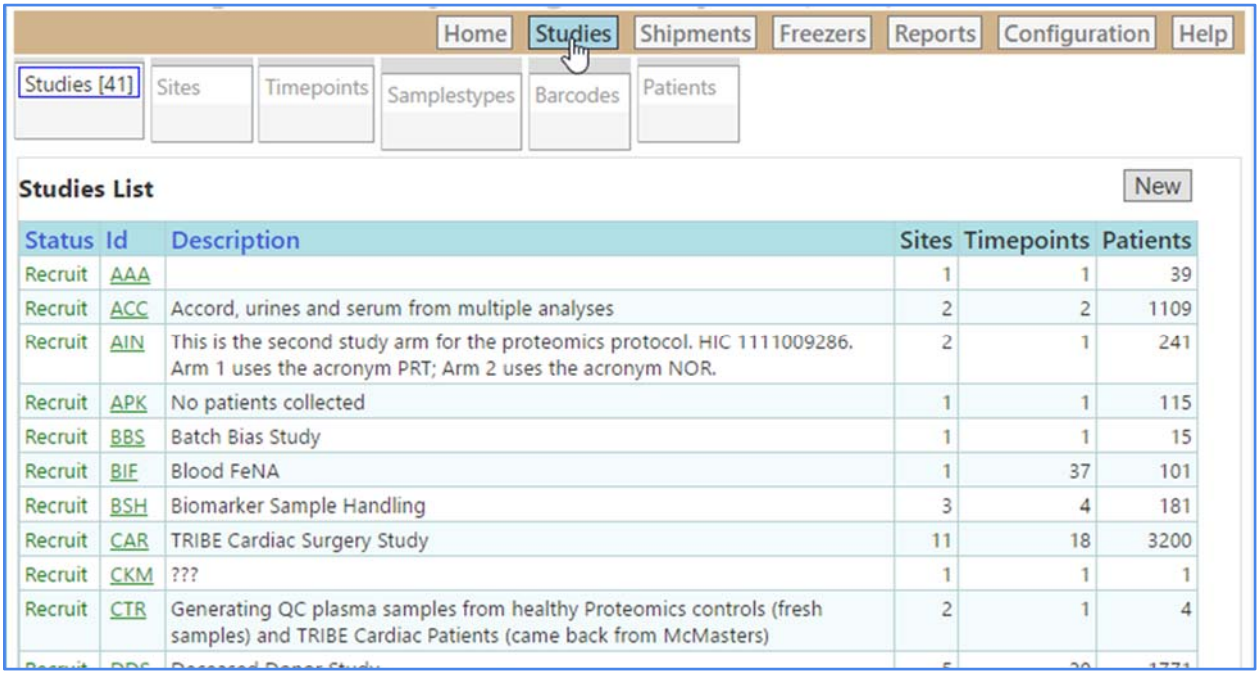


The freezers breadcrumb menu below shows that the sample is in Location 4 out of 479 locations in the freezer HUMMER, which is one of 21 freezers in the system.



2 Studies

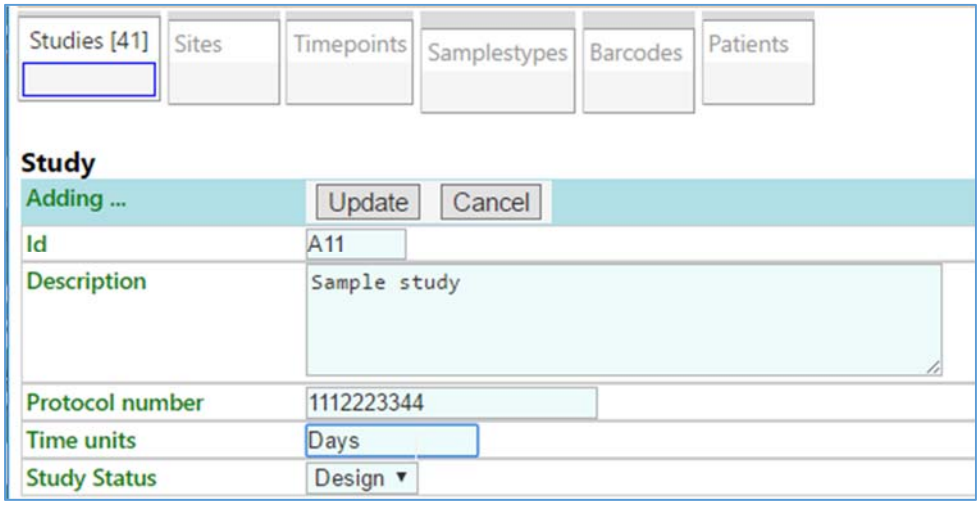
From the main menu, click on Studies to show the summary list of all studies in the system. Click on an ID to access study details.



Status	Id	Description	Sites	Timepoints	Patients
Recruit	AAA		1	1	39
Recruit	ACC	Accord, urines and serum from multiple analyses	2	2	1109
Recruit	AIN	This is the second study arm for the proteomics protocol. HIC 1111009286. Arm 1 uses the acronym PRT; Arm 2 uses the acronym NOR.	2	1	241
Recruit	APK	No patients collected	1	1	115
Recruit	BBS	Batch Bias Study	1	1	15
Recruit	BIF	Blood FeNA	1	37	101
Recruit	BSH	Biomarker Sample Handling	3	4	181
Recruit	CAR	TRIBE Cardiac Surgery Study	11	18	3200
Recruit	CKM	???	1	1	1
Recruit	CTR	Generating QC plasma samples from healthy Proteomics controls (fresh samples) and TRIBE Cardiac Patients (came back from McMasters)	2	1	4

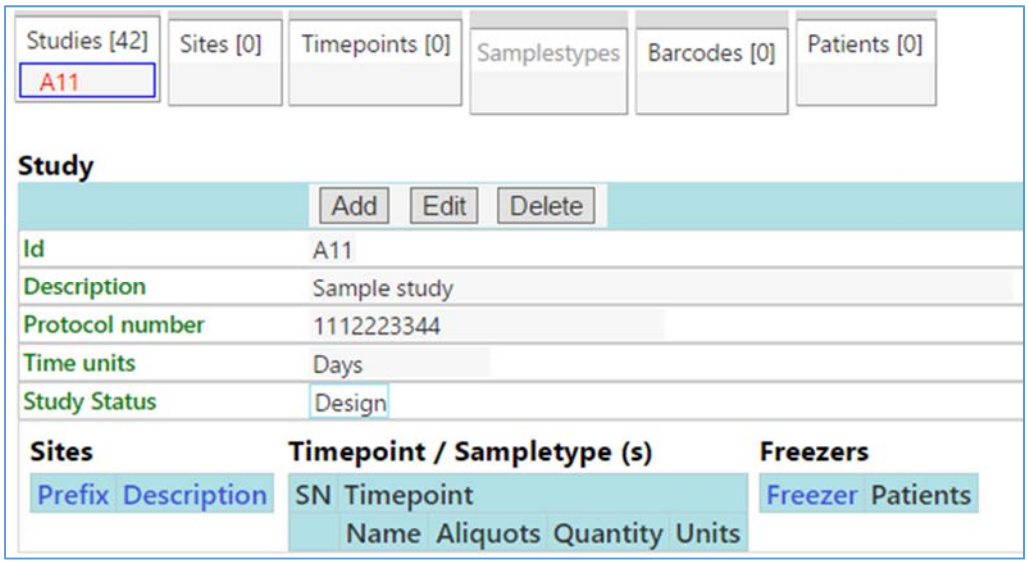
2.1 Creating a New Study

Click on [New] to create a new study and enter the appropriate information.



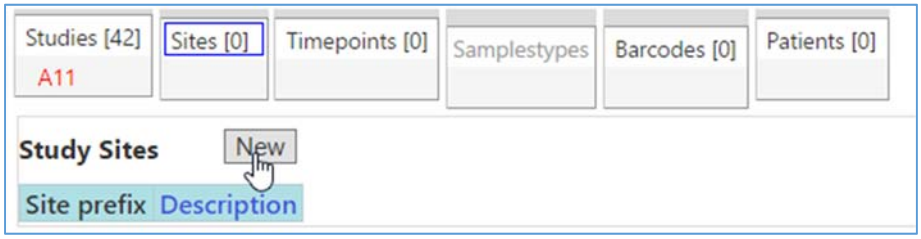
2.2 Study Protocol

Then, when a study is given the “Design” status, we can proceed to make changes to the study protocol (sites, timepoints, and time point - sample types).



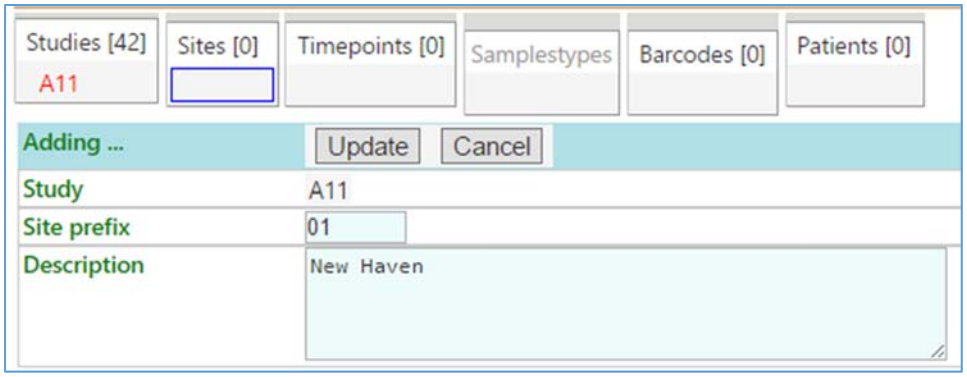
2.2.1 Study Sites

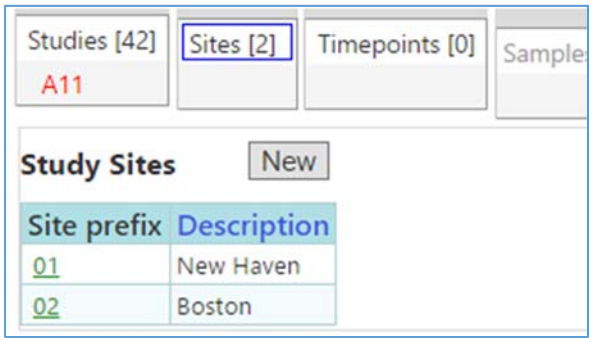
Select “sites” from the breadcrumbs menu, and click “New.”



Enter the site information. Hit update. Repeat for other sites.

Note: site prefix is important as it will be used to generate patient IDs. Site prefixes should be unique within a study.

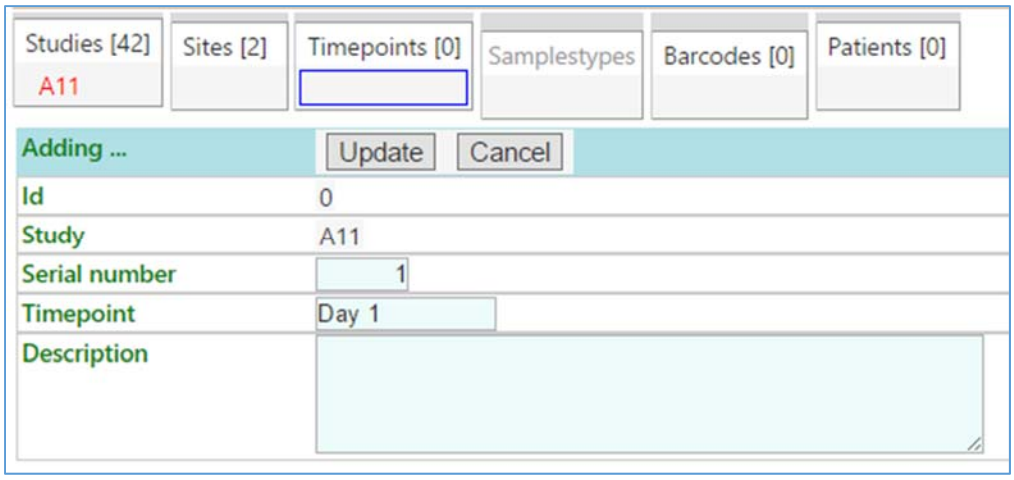




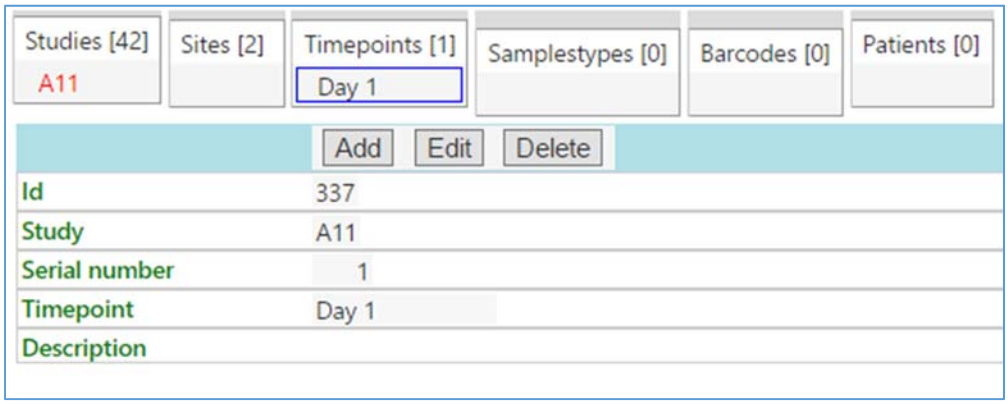
Once finished with all study sites, proceed to the study timepoints at which samples are collected.

2.2.2 Timepoints

Click on “Timepoints” and select “New” to enter the new time point information.



Click “Update”.

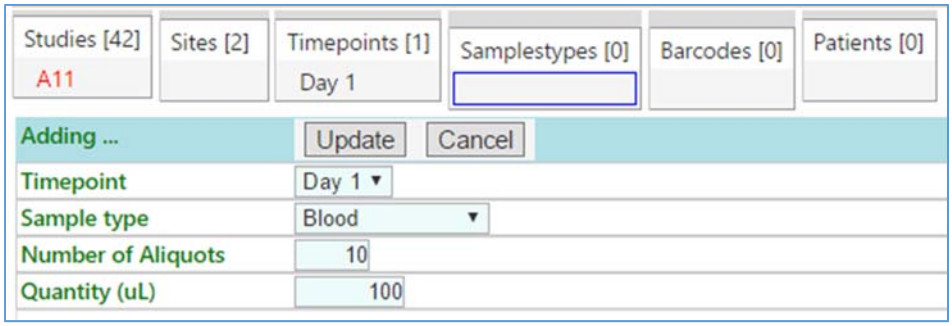


Once the new time point has been generated, we can either continue generating more timepoints or add sample types to this timepoint.

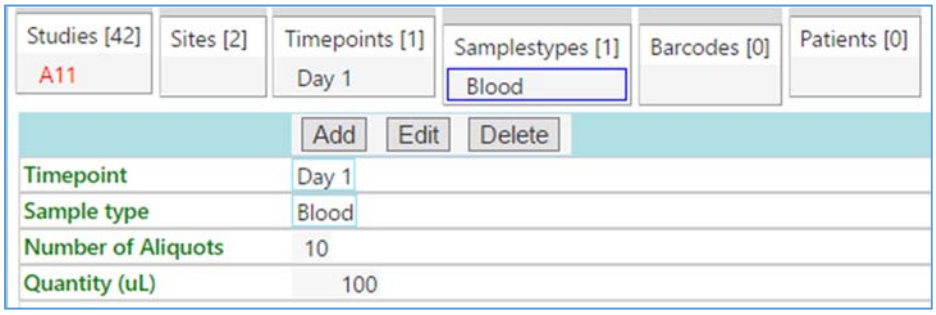
2.2.3 Timepoint - Sample Types

After selecting a specific Timepoint, click on “Samplestypes,” and then “New.” The next form allows you to choose a sample type from the list available on the system, specify the number of aliquots to be collected, and the quantity of each. Barcodes are generated for the number of aliquots specified. **Note:** Sample types are linked to specific timepoints, so if you need Urine samples for Day 1, 2, and 3, you will need to add this sample type to the three timepoints separately.

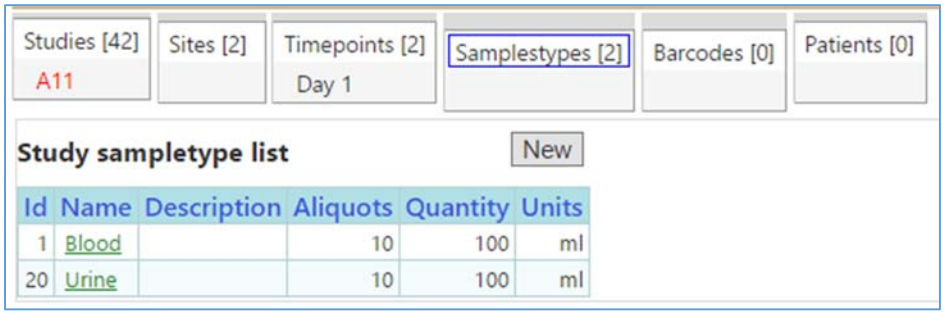
If a needed sample type is not in the list, ask a system administrator to add it for you.



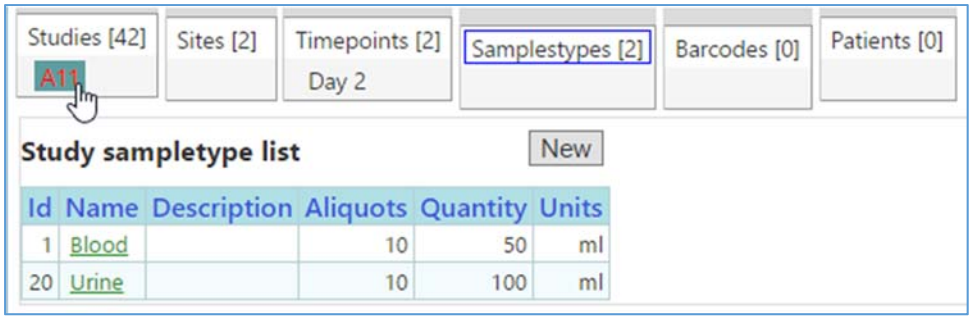
Once a sample type is added, we can continue adding more for this specific time point.



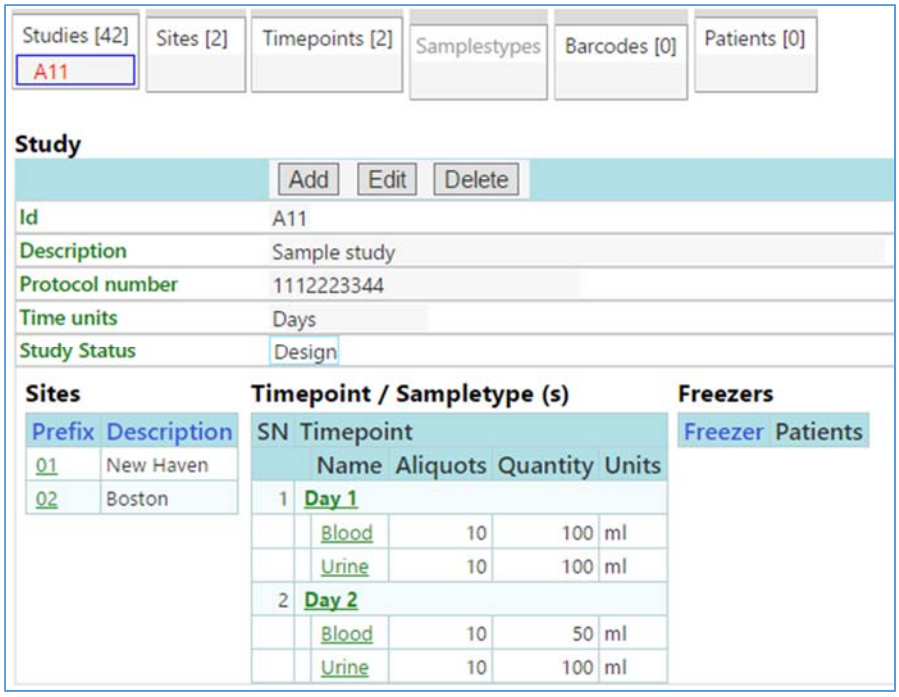
In this case we added one more, “Urine.” When we click on “Samplestypes”, we can see the full list of samplestypes for this Timepoint.



To add more timepoints, click on “Timepoints”, and then “New.” We repeated the same steps above for a Timepoint called Day 2.

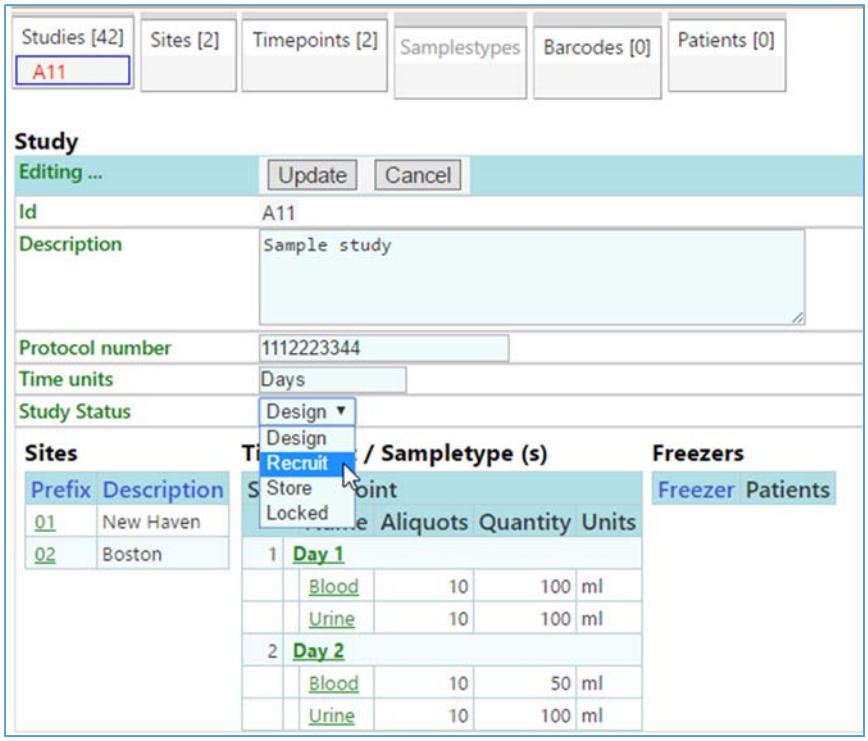


While in design mode (when the study ID is red), we cannot add patients or scan barcodes. To do this, we need to click on the study to go to the study description page. This page shows the full protocol detail of the study, plus the number of patient samples located within specific freezers.

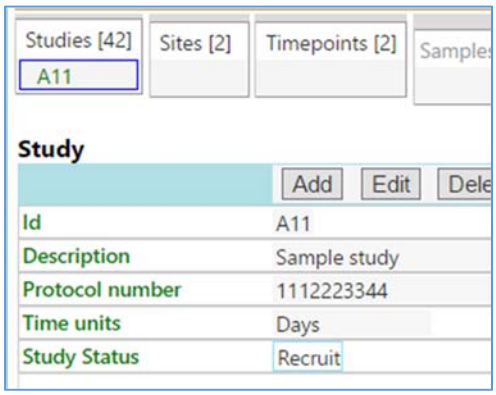


2.2.4 Changing Study Status

To do this, we click “Edit” to change the study status from “Design” to “Recruit.”

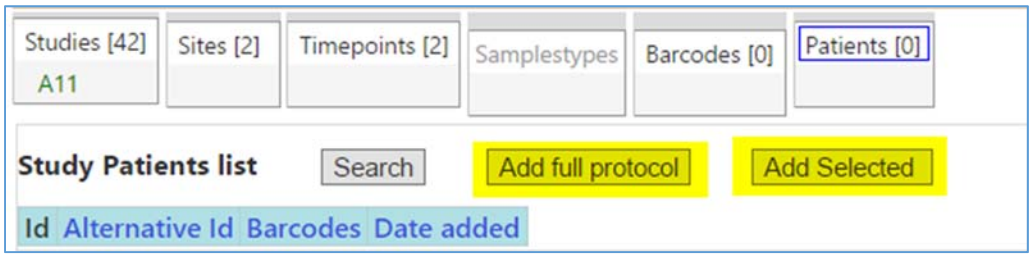


This new status will allow us to add patients. Notice how the study color changes to green.



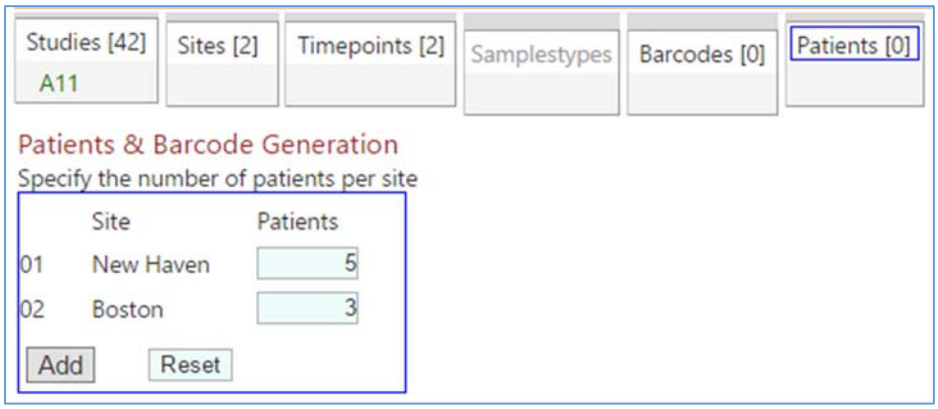
2.3 Patients

For a selected study, click on patients. (The study must be in Recruit mode.) You will be presented with two options to add patients: “Add full protocol” and “Add selected.”

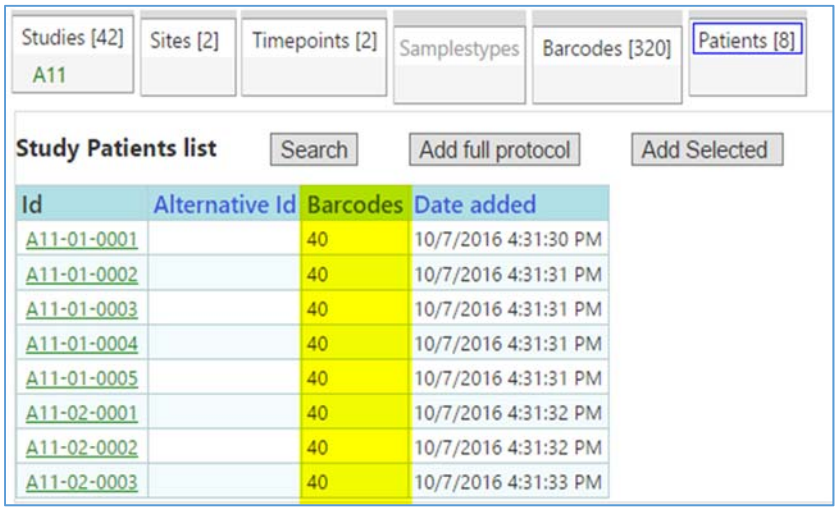


2.3.1 Adding Full Protocol Patients

“Add full protocol” will generate all barcodes for all timepoint-sample types combinations specified in the protocol. The next form will ask for the number of patients for each of the sites that were entered in the protocol. In this case, we add 5 and 3 for the sites New Haven and Boston, respectively. Then we click “Add”.

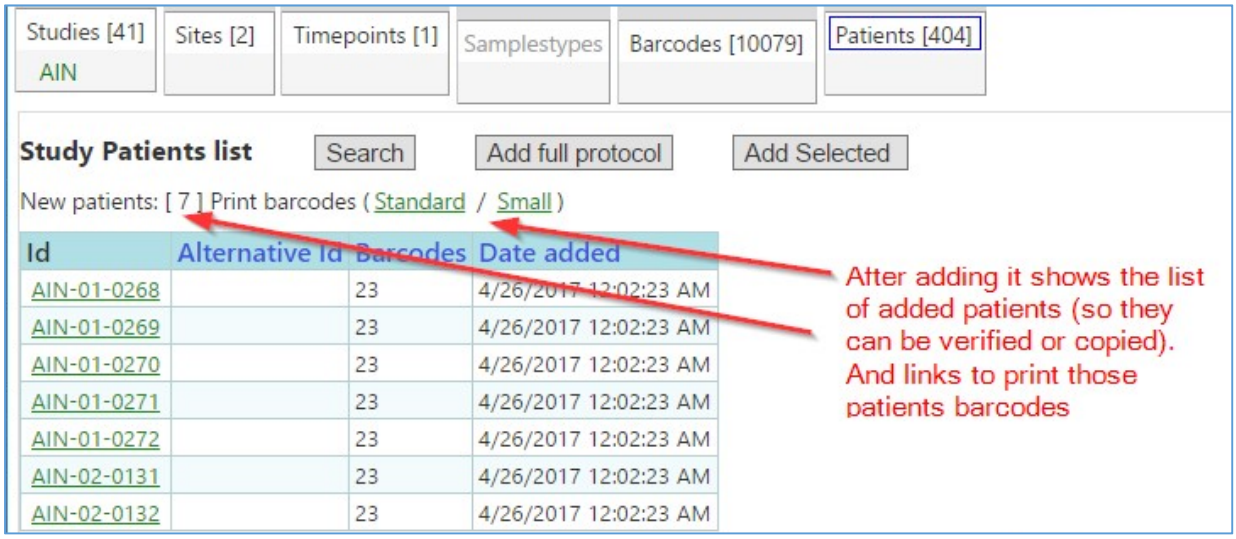


The next form shows that 8 new patients in total were added, with 40 barcodes for each. These 40 barcodes are from 10 aliquots for each of the 4 sample types (2 on each time point) in the protocol created. Patient IDs are automatically generated by the system using the following method. Study Id (3 chars) + "-" + Site Id (2 chars) + "-" + sequence number (4 chars). (e.g.: "A11-01-0001")



Id	Alternative Id	Barcodes	Date added
A11-01-0001		40	10/7/2016 4:31:30 PM
A11-01-0002		40	10/7/2016 4:31:31 PM
A11-01-0003		40	10/7/2016 4:31:31 PM
A11-01-0004		40	10/7/2016 4:31:31 PM
A11-01-0005		40	10/7/2016 4:31:31 PM
A11-02-0001		40	10/7/2016 4:31:32 PM
A11-02-0002		40	10/7/2016 4:31:32 PM
A11-02-0003		40	10/7/2016 4:31:33 PM

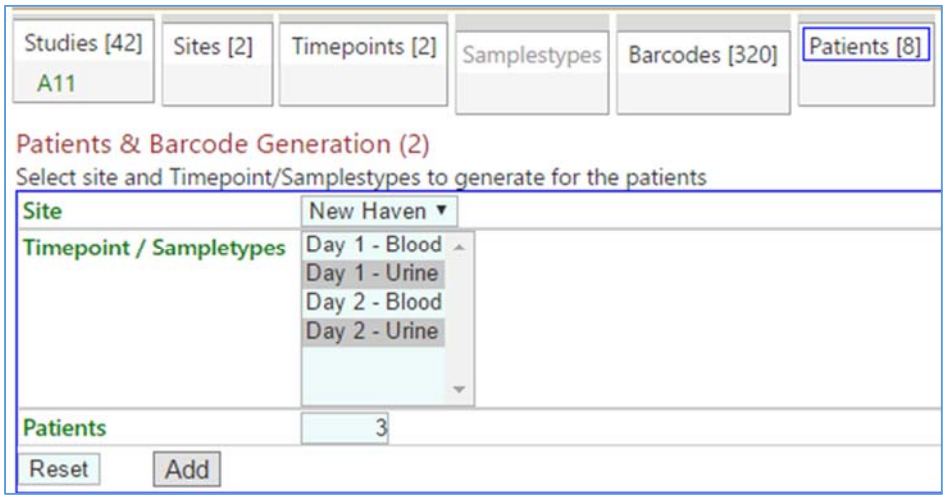
Additionally, you can print all the barcodes for these patients as seen in the screenshot below.



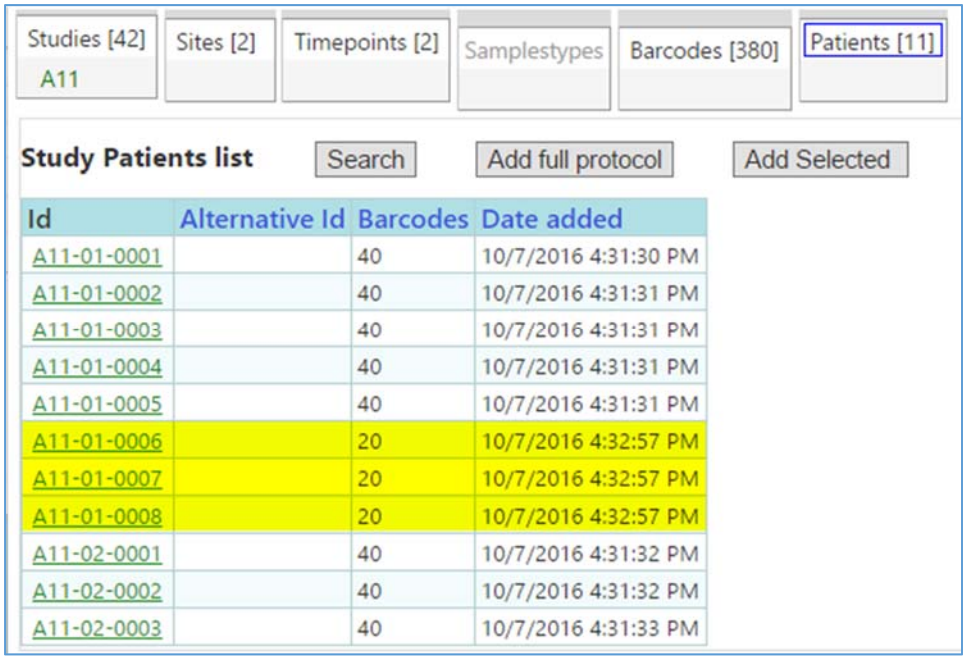
Id	Alternative Id	Barcodes	Date added
AIN-01-0268		23	4/26/2017 12:02:23 AM
AIN-01-0269		23	4/26/2017 12:02:23 AM
AIN-01-0270		23	4/26/2017 12:02:23 AM
AIN-01-0271		23	4/26/2017 12:02:23 AM
AIN-01-0272		23	4/26/2017 12:02:23 AM
AIN-02-0131		23	4/26/2017 12:02:23 AM
AIN-02-0132		23	4/26/2017 12:02:23 AM

2.3.2 Adding Selected Protocol Patients

This method for adding patients will allow you to add barcodes for specific portions of the protocol. The next form shows adding Day 1 and Day 2 urine barcodes (hold Ctr key to select more than one sampletype) for 3 patients in the New Haven site.



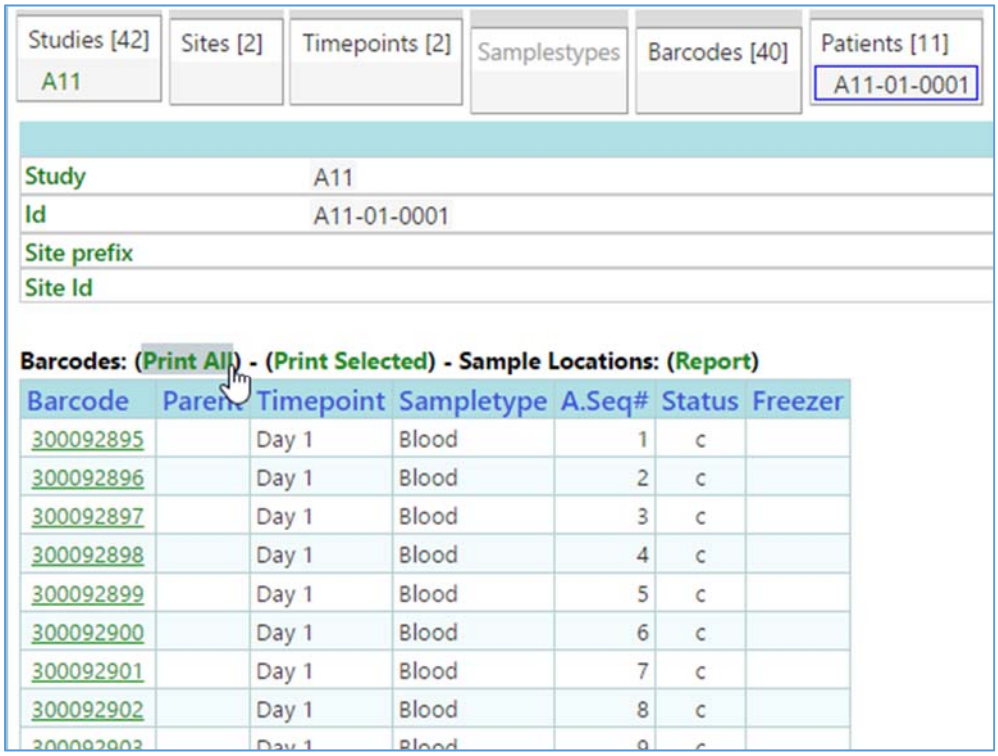
After clicking on “Add”, we see highlighted in yellow below the 20 barcodes added to each of the 3 new patients in the New Haven (01) site.



Id	Alternative Id	Barcodes	Date added
A11-01-0001		40	10/7/2016 4:31:30 PM
A11-01-0002		40	10/7/2016 4:31:31 PM
A11-01-0003		40	10/7/2016 4:31:31 PM
A11-01-0004		40	10/7/2016 4:31:31 PM
A11-01-0005		40	10/7/2016 4:31:31 PM
A11-01-0006		20	10/7/2016 4:32:57 PM
A11-01-0007		20	10/7/2016 4:32:57 PM
A11-01-0008		20	10/7/2016 4:32:57 PM
A11-02-0001		40	10/7/2016 4:31:32 PM
A11-02-0002		40	10/7/2016 4:31:32 PM
A11-02-0003		40	10/7/2016 4:31:33 PM

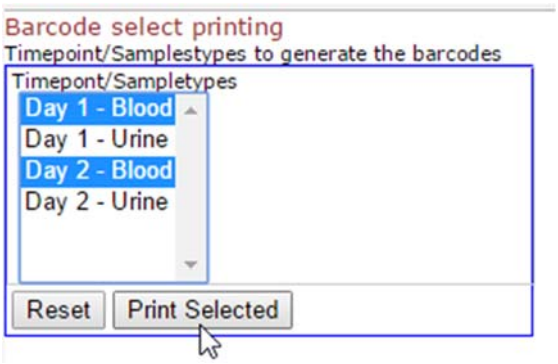
If we click on a patient, a list of the 40 barcodes is displayed. Each of the barcodes has the status “Created.”

2.3.3 Patient Barcode Printing



While on any patient page, clicking “Print All”, displays a page with all barcodes for that patient using label print format (5x12). Right click or press Ctr-P to print. Check that by default your browser does not add page counter, headers or footers.

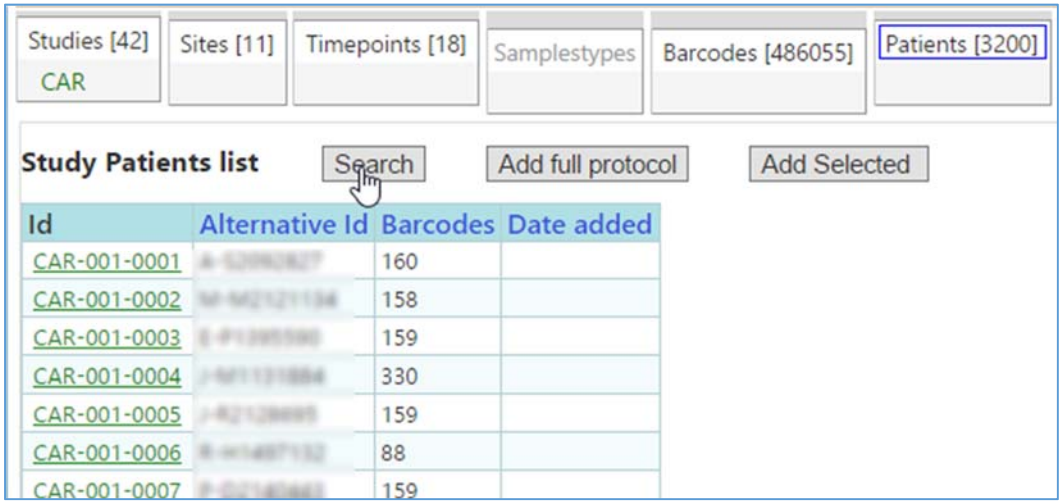
Clicking on “Print Selected”, will pull up a form to select specific timepoint - sample type barcodes for a patient.



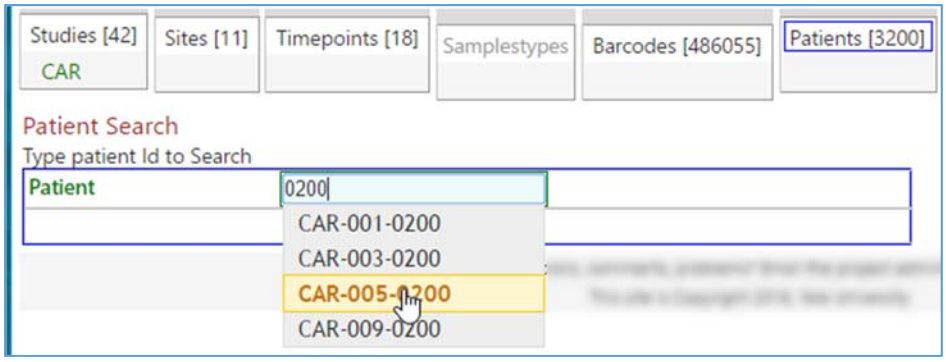
Additional ways to print desired barcodes can be reached under “Reports” on the main menu. More details on how to use them can be found later in this manual.

2.3.4 Searching for Patients

When a large number of patients are in a study, navigating through many pages can be cumbersome. The search button provides a form to search for patients.

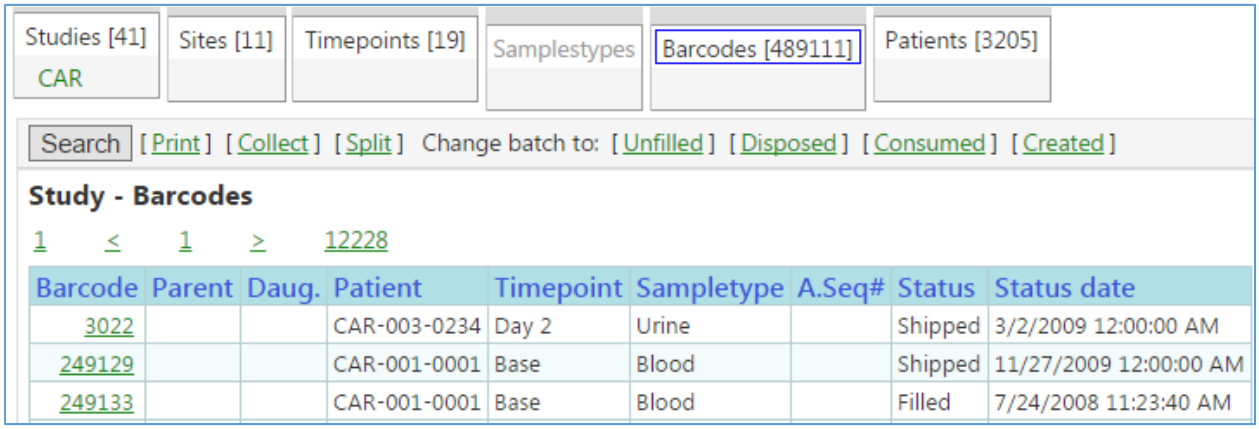


Type in a few characters (3 or more) to search for and select the desired patient.



2.4 Samples/Barcodes

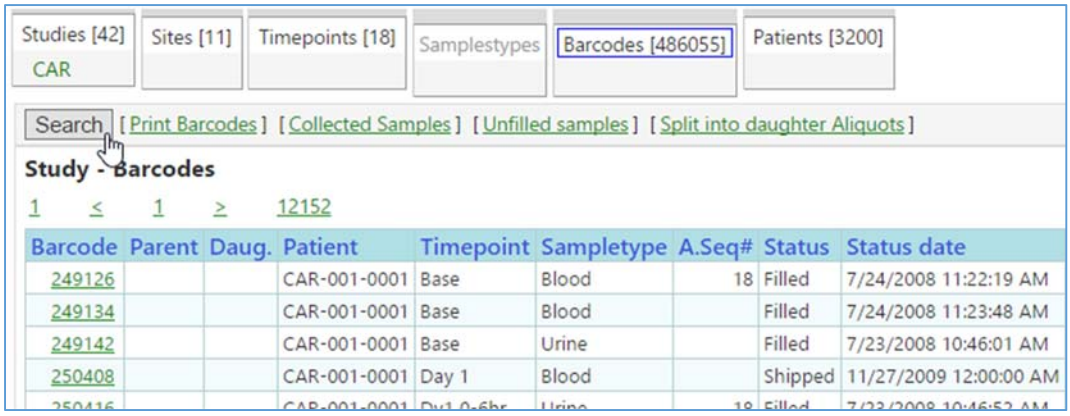
Samples can be managed only on studies that are in Recruit or Store mode. The difference is that in Store mode, no more patients can be added to the study. To process samples in a given study, select “Barcodes”, from the breadcrumbs bar.



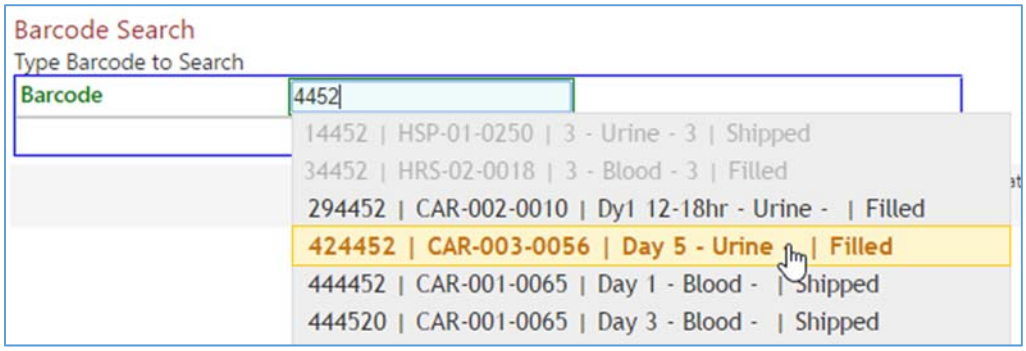
Immediately below the breadcumbs bar are listed the main operations that can be performed on samples: search, printing, collecting (scanning), and splitting barcodes into daughter aliquots. These operations are described below. If you are an administrator, you will also have access to the batch functions on the right: unfilled, disposed, consumed, and created. These functions will change a list of barcodes to the status which you select. More details will be listed below.

2.4.1 Barcode Search

This function allows you to quickly find a barcode in a study without needing to browse through hundreds of them. Just click “Search.”

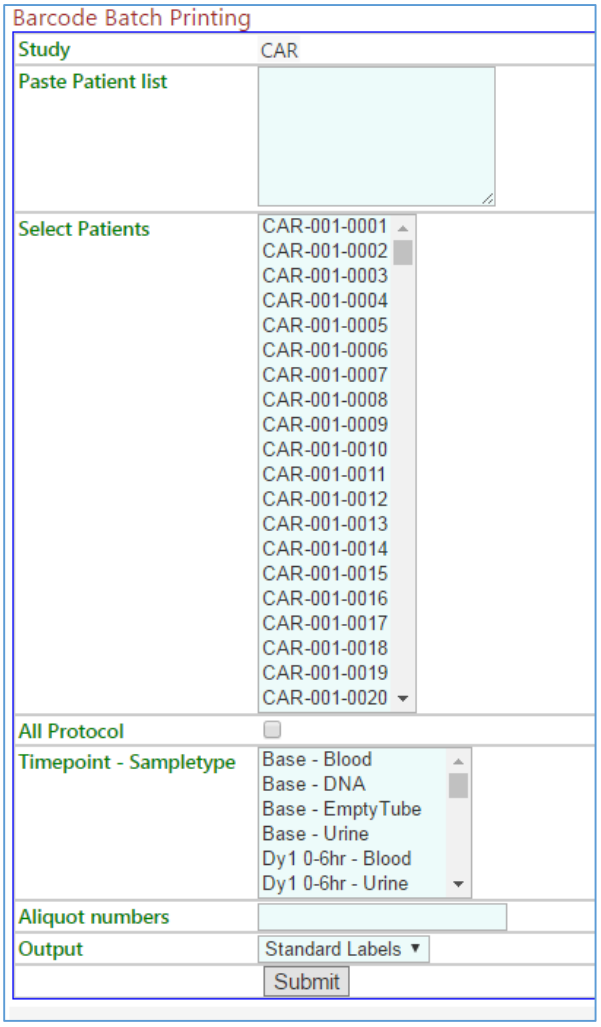


Type a few characters of the barcode, and select from the list. Note in the figure below, that to help identify all barcodes, some barcodes from other studies may be listed, but are non-selectable.



2.4.2 Printing Barcodes

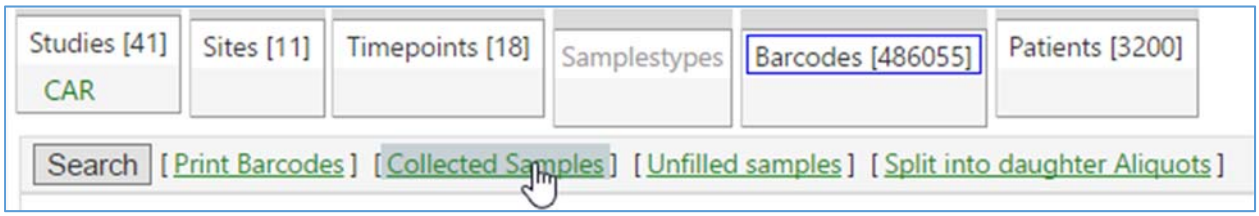
In addition to being able to print barcodes in the patient section, you can also print barcodes of several patients in one single batch. From the samples menu bar just below the breadcrumbs menu, select “Print Barcodes”. The next form allows you to select a range of patients IDs, timepoint-sampletype combinations, and aliquots to print their barcodes in one batch.

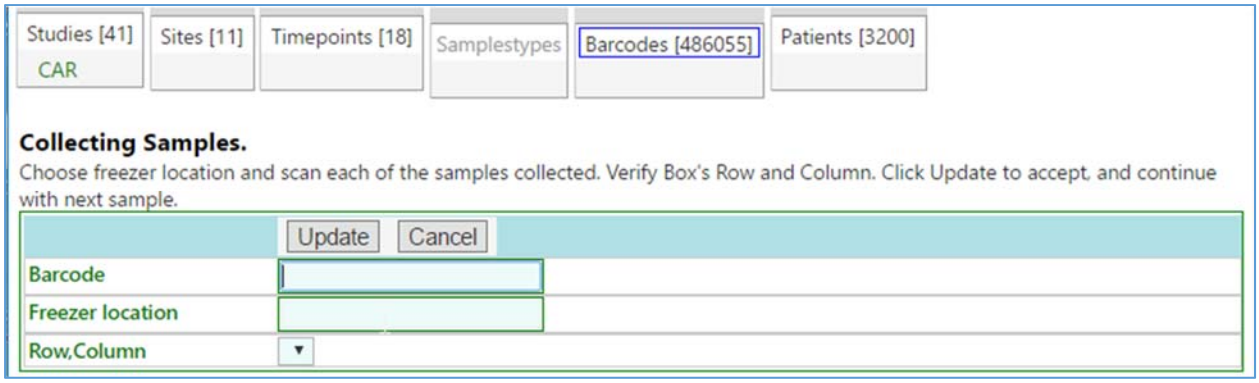


2.4.3 Collecting Samples

Once the barcodes are generated, printed, and stuck on vials, they are available to be filled with samples. When filled, they are placed in boxes, scanned, and stored in freezers.

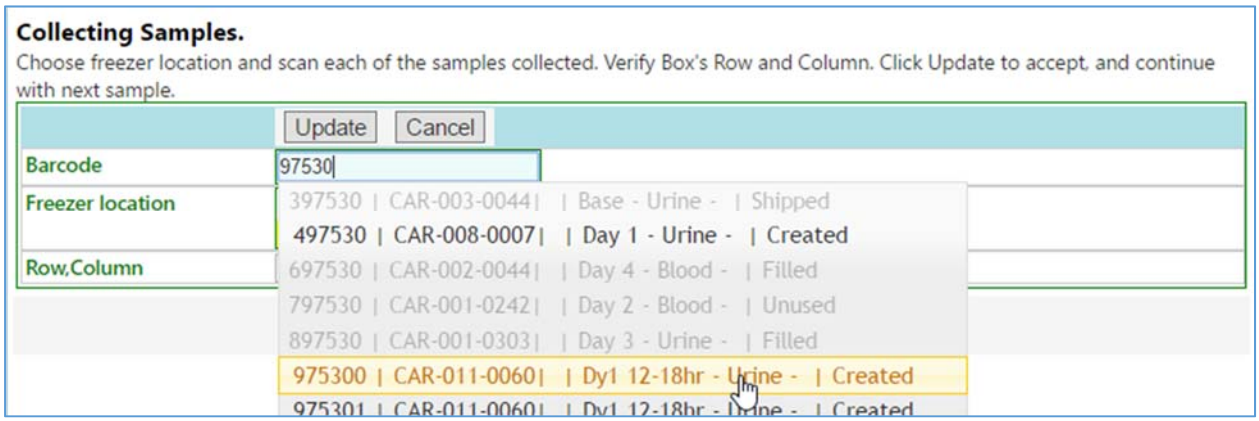
To start this procedure, select “Collected Samples” from a study’s “Barcodes” page. This function can also be accessed from a link on the home page. In that instance, you must select the desired study before reaching the “Collected Samples” function.



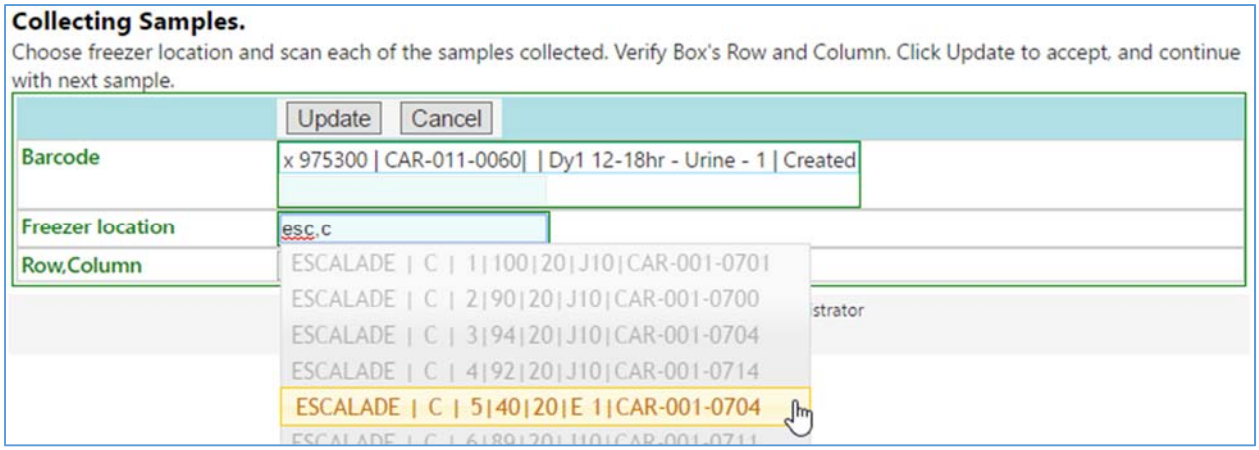


On the next form, scan or type in the barcode. Note that barcodes from all studies can be shown in here, but only those in the study that are ready to be collected (created status) will be selectable. If you are using a barcode reader, a valid full barcode will be entered, the system will automatically select it, and advance to the freezer location box.

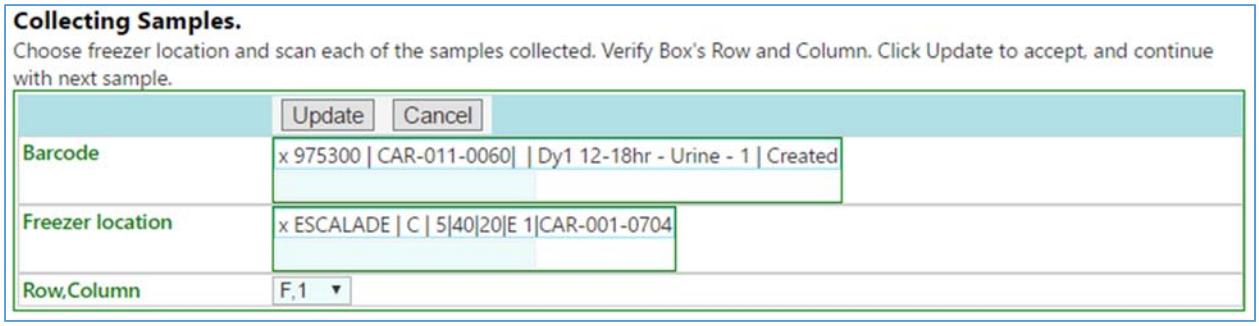
Below is an example of typing in a selected sample:
In the drop-down list, it is shown the patient id, timepoint, sampletype and status.



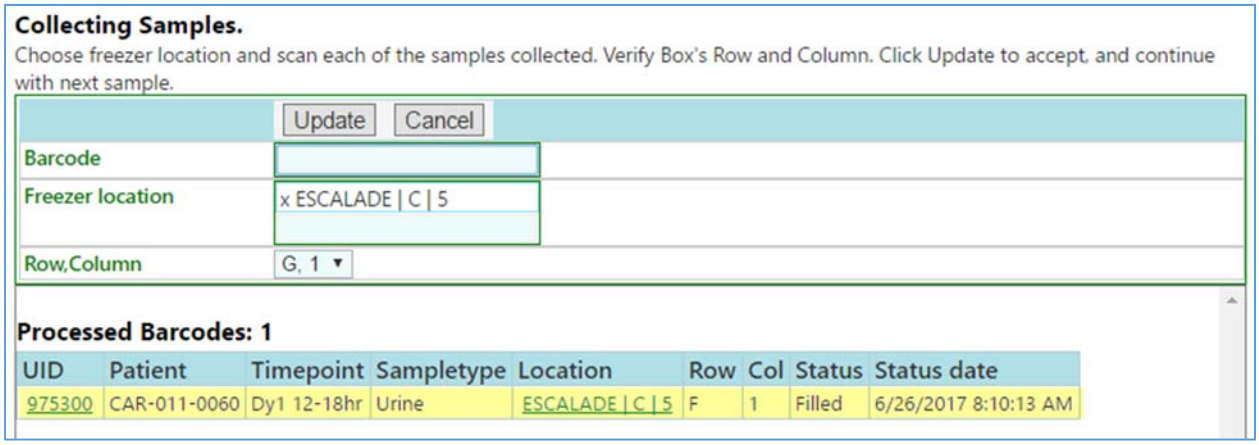
Then, in the freezer location box, type a few characters of a freezer name. A full list of all locations of that freezer is shown. To make the list more specific, type a comma “,” and the rack (e.g.”c”) to further narrow the list. In the drop-down list, it is shown: freezer name, rack, slot number, number of current samples in the box, sampletype id (20=urine), last used box row (E1) and patient id.



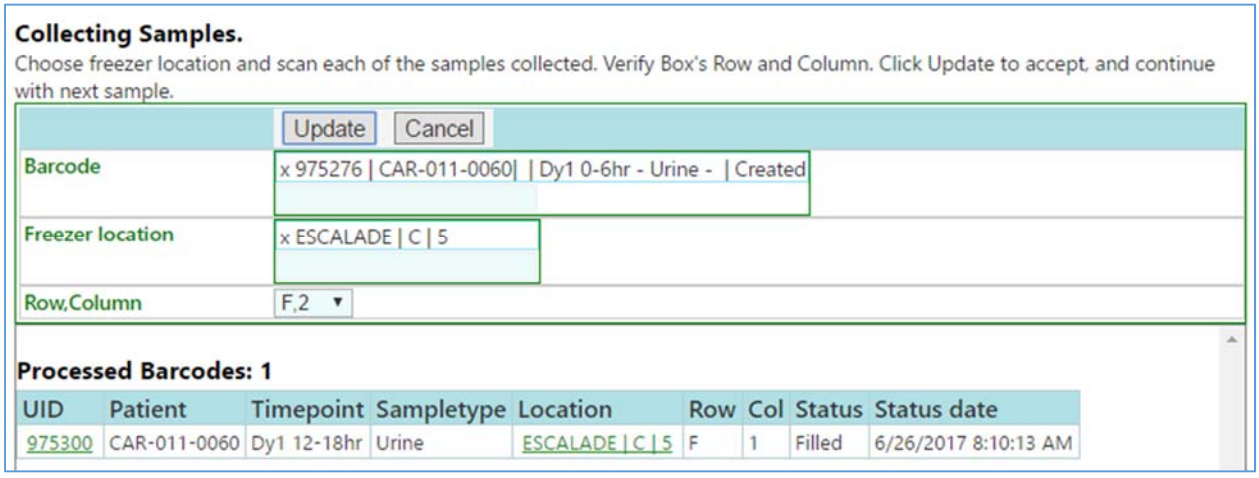
The system checks on the box located in that freezer location for available row/columns positions, and presents the next available for the current patient/sample. Leave or select a different position and click update or hit [Enter].



On the next screen, we see a new entry form, with confirmation that a sample has been marked as collected in the “processed barcodes” table highlighted below. Note like before that the Row, Column has been updated to next row. That will be used or updated in case the next barcode belongs to the same patient or a new one.

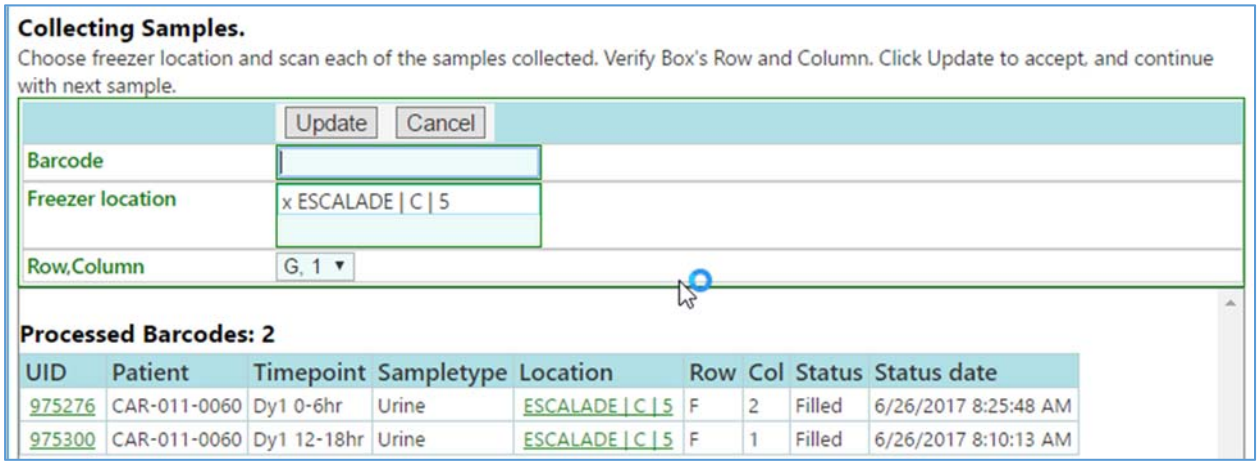


If we chose a new sample from the same patient, the Row,Column will be updated to F2; the next available position for the same patient.



SIMS will prepopulate Freezer location and Row,Column with the next available row, but this will change to the next available location when the barcode is scanned. Once the first barcode has been scanned, you will not need to click update anymore. Instead, you can hit Enter to update after all the information for the next barcode you scan has loaded. **Note:** You MUST wait for the barcode information to load in after scanning. Failure to do so before hitting enter will clear the box. Additionally, you must wait until the Row,Column field has finished updating as well or else the sample will scan in without this information.

After updating the new entry is displayed in the processed barcodes table.



Note: Once a box is filled, the user must advance to the next freezer location, as the system will not move to the next available box automatically.

If you wish to skip a space in the box, manually select the Row,Column location and SIMS will continue from there.

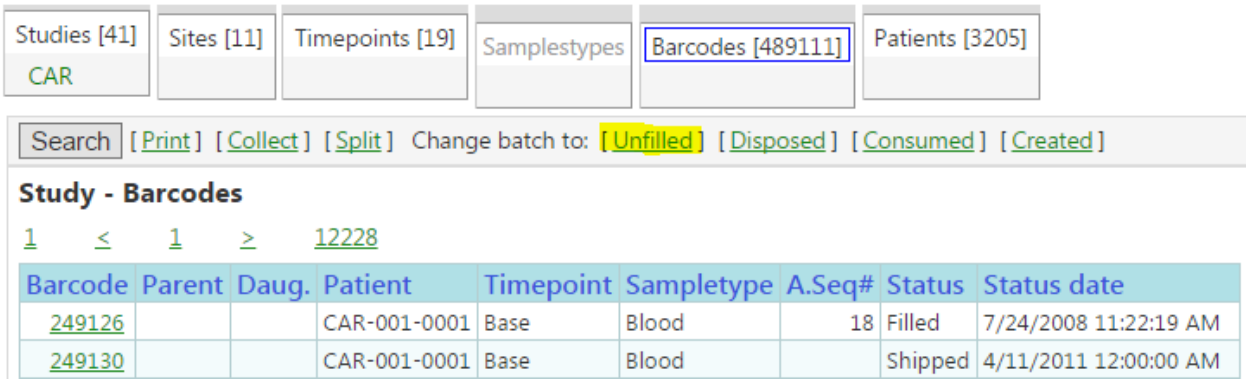
2.4.3.1 Troubleshooting Scanning Issues

- Desired Freezer location cannot be selected
    - Check that the barcode you scanned is of the same study as the rest of the box.
    - Check that the sampletype is the same.
    - If the last row in the box is filled, you cannot use the scanning module. Ask an administrator to edit the barcodes you wish to scan manually from their records, or batch change the last row to “created” before rescanning all samples.
- Desired row,column cannot be selected
    - If the sample is NOT DNA, ExtraUrine, or ExtraPlasma check that the sample belongs to the same patient as the rest of the samples in the row.

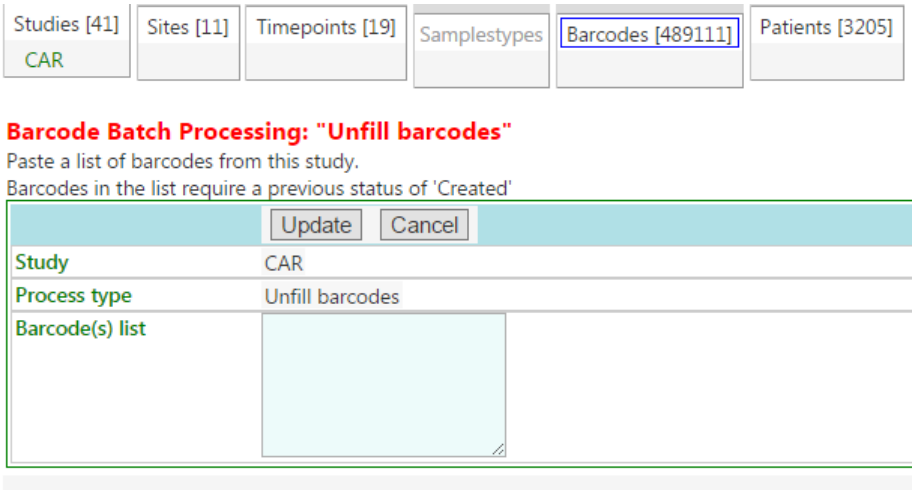
2.4.4 Unfilled Samples

Sometimes collecting all samples is not possible. Barcodes left unused can be reported to the system in the following way by an administrator.

From a study’s “Barcodes” page, select “Unfilled Samples.”



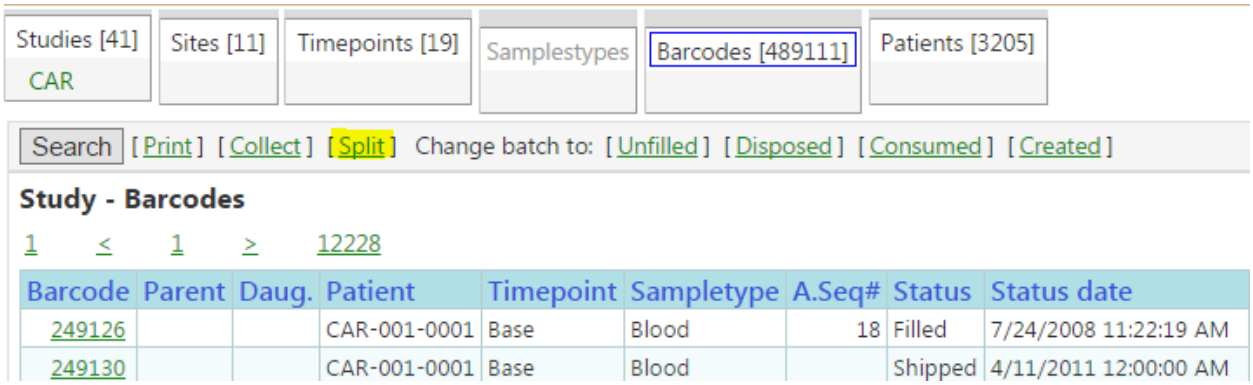
On the next screen, paste a list of unused barcodes separated by hard returns. Make sure there is no return at the end of the list.



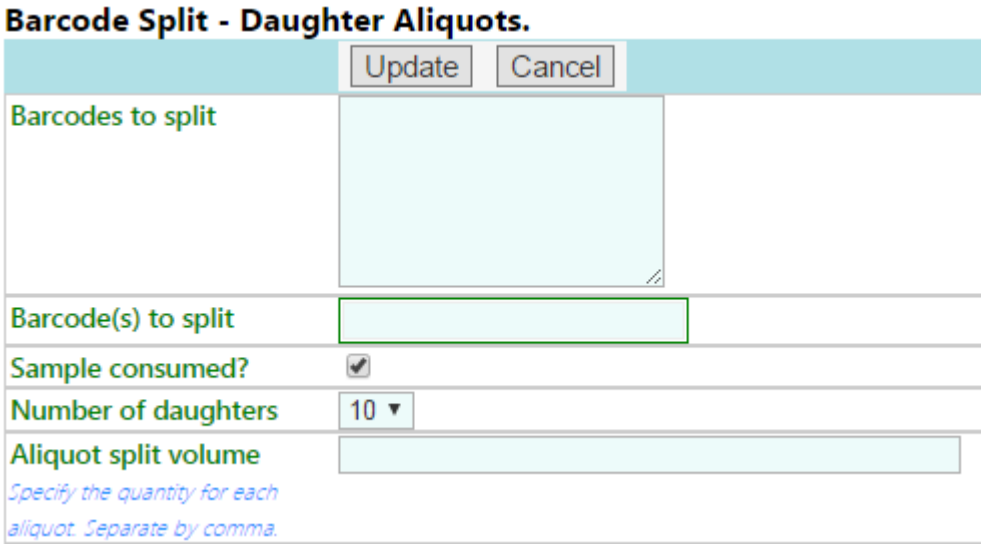
On the next screen, confirmation is displayed of the processed barcodes below, including the total count on the current session.

2.4.5 Daughter Aliquot Generation

Sometimes a sample needs to be split into smaller containers. This is initiated by selecting “Split”.

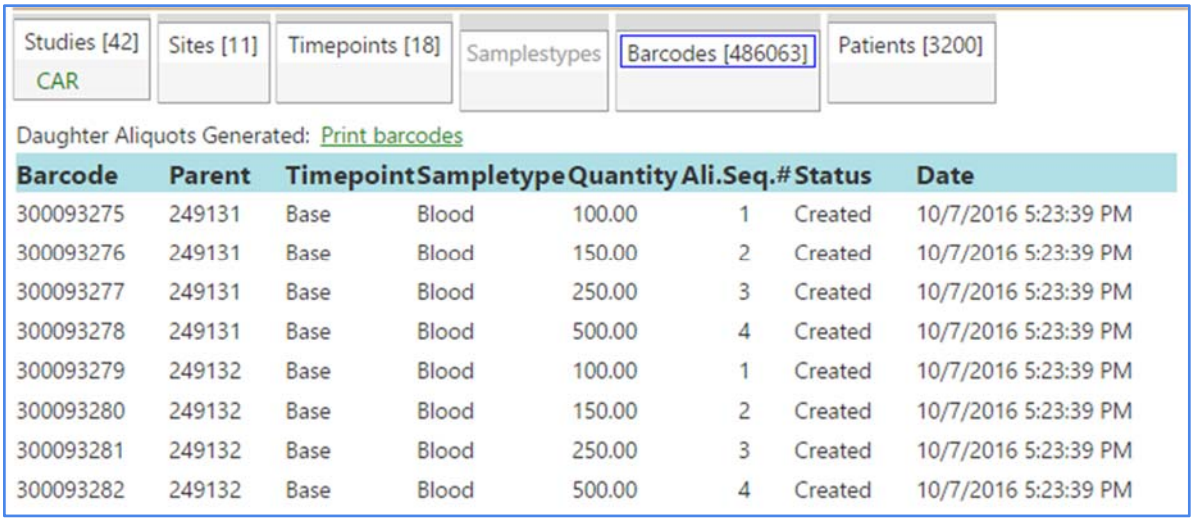


This process can be applied to one or more filled samples by pasting in a list separated by hard returns. After entering them, specify if the parent samples will be entirely consumed*, the number of daughters generated, and the volume of each of the daughter aliquots (use a single quantity for all, or one value for each daughter in the sequence). Separate values with a comma.



***Note:** If generating daughters for samples which will filled elsewhere, do NOT check “Sample consumed?”. You will ship the parents out to create a verifiable manifest.

After the daughter aliquots are generated, we can print their labels, affix them to new vials, resample the parent, and discard the parent container if consumed.



Barcode	Parent	Timepoint	Sampletype	Quantity	Ali.Seq.#	Status	Date
300093275	249131	Base	Blood	100.00	1	Created	10/7/2016 5:23:39 PM
300093276	249131	Base	Blood	150.00	2	Created	10/7/2016 5:23:39 PM
300093277	249131	Base	Blood	250.00	3	Created	10/7/2016 5:23:39 PM
300093278	249131	Base	Blood	500.00	4	Created	10/7/2016 5:23:39 PM
300093279	249132	Base	Blood	100.00	1	Created	10/7/2016 5:23:39 PM
300093280	249132	Base	Blood	150.00	2	Created	10/7/2016 5:23:39 PM
300093281	249132	Base	Blood	250.00	3	Created	10/7/2016 5:23:39 PM
300093282	249132	Base	Blood	500.00	4	Created	10/7/2016 5:23:39 PM

A daughter aliquot always has the barcode of its parent listed in the “Parent” column, and if a parent has been split into daughters, the number of daughters it has is listed in the “Daughter” column. If you select a parent’s barcode, the records for its daughters are listed in its sample details.

2.4.6 Shipping Samples

This operation is explained in the Shipping section later.

2.4.7 Summary

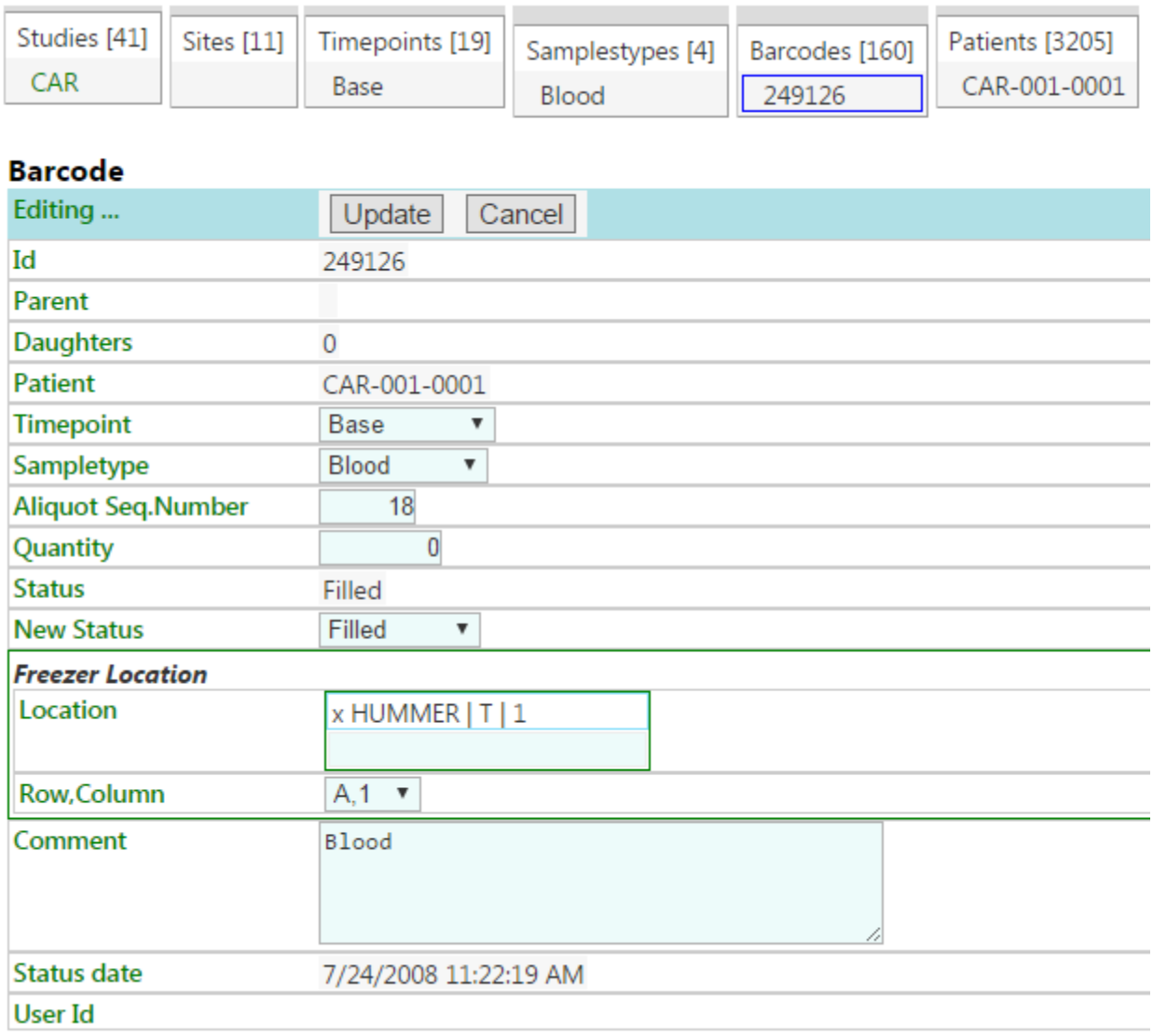
Abbreviations for barcode status are listed below as a recap. This is available under “Configuration.”

Barcode Status List

Id	Previous	Sequence	Name	Description
?		1	Unknown	Undetermined satus
c		2	Created	Generated by the system. Pending collection
f	c	3	Filled	Sample was collected and should be located in a freezer box
e	f	4	Consumed	Used by the lab
u	c	5	Unused	Sample was not collected
s	f	6	Shipped	Aliquot was shipped out
d	f	8	Disposed	Aliquot has been disposed/destroyed

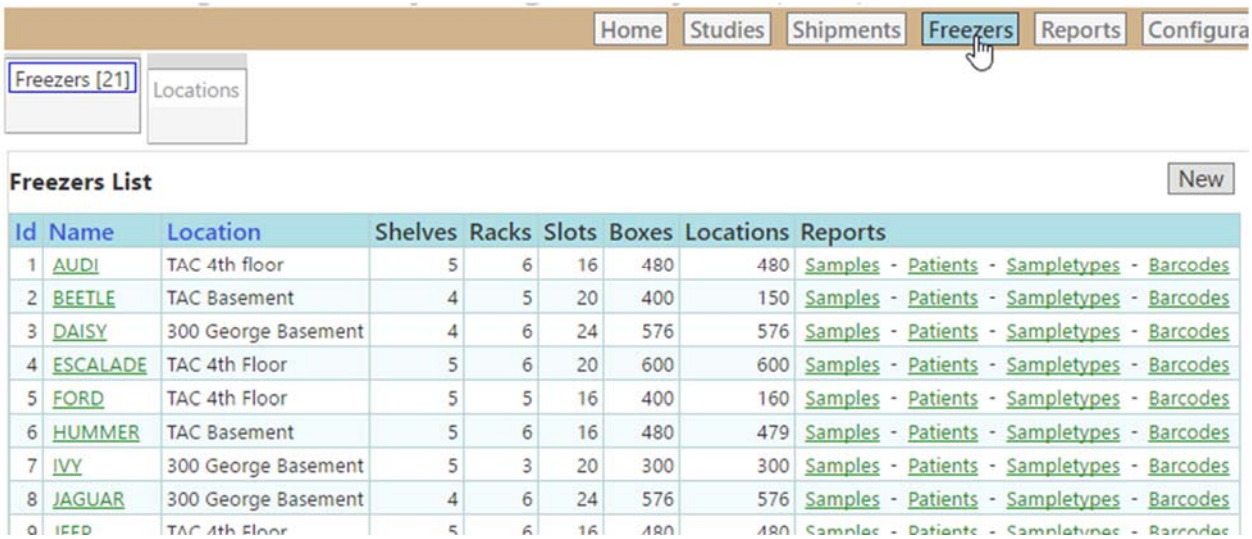
2.4.8 Manual Barcode Changes

This function is available to administrators. After selecting a barcode record, click “Edit.” This will open the fields for changes after which you must select “Update” to save changes.



3 Freezers

Samples are stored in freezers. We access the freezer list on the main menu bar.

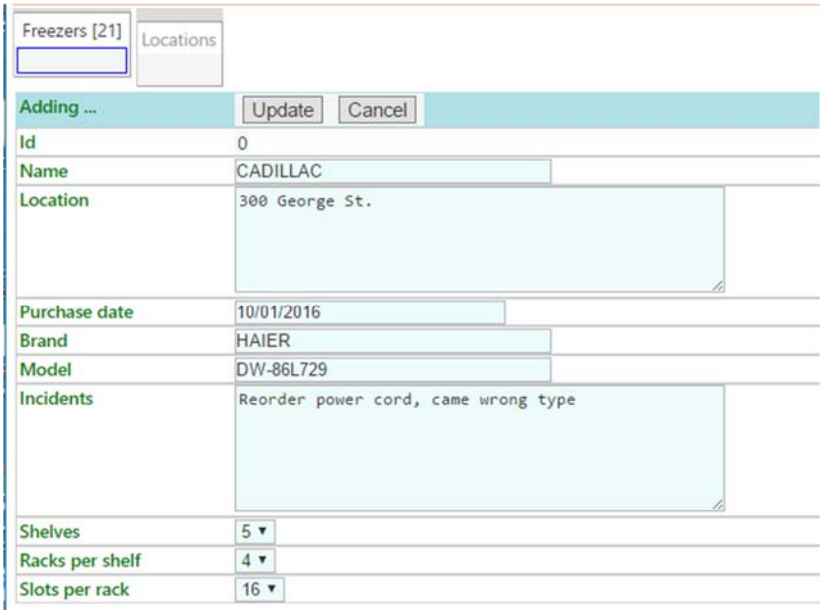


Id	Name	Location	Shelves	Racks	Slots	Boxes	Locations	Reports
1	AUDI	TAC 4th floor	5	6	16	480	480	Samples - Patients - Sampletypes - Barcodes
2	BEETLE	TAC Basement	4	5	20	400	150	Samples - Patients - Sampletypes - Barcodes
3	DAISY	300 George Basement	4	6	24	576	576	Samples - Patients - Sampletypes - Barcodes
4	ESCALADE	TAC 4th Floor	5	6	20	600	600	Samples - Patients - Sampletypes - Barcodes
5	FORD	TAC 4th Floor	5	5	16	400	160	Samples - Patients - Sampletypes - Barcodes
6	HUMMER	TAC Basement	5	6	16	480	479	Samples - Patients - Sampletypes - Barcodes
7	IVY	300 George Basement	5	3	20	300	300	Samples - Patients - Sampletypes - Barcodes
8	JAGUAR	300 George Basement	4	6	24	576	576	Samples - Patients - Sampletypes - Barcodes
9	JEEP	TAC 4th Floor	5	6	16	480	480	Samples - Patients - Sampletypes - Barcodes

This list shows a summary of all freezers, including the number of boxes that a freezer can hold. This quantity is calculated from the product of the shelves, racks, and slots. The number of boxes should match the number of locations. If you are a system administrator, you can add new freezers.

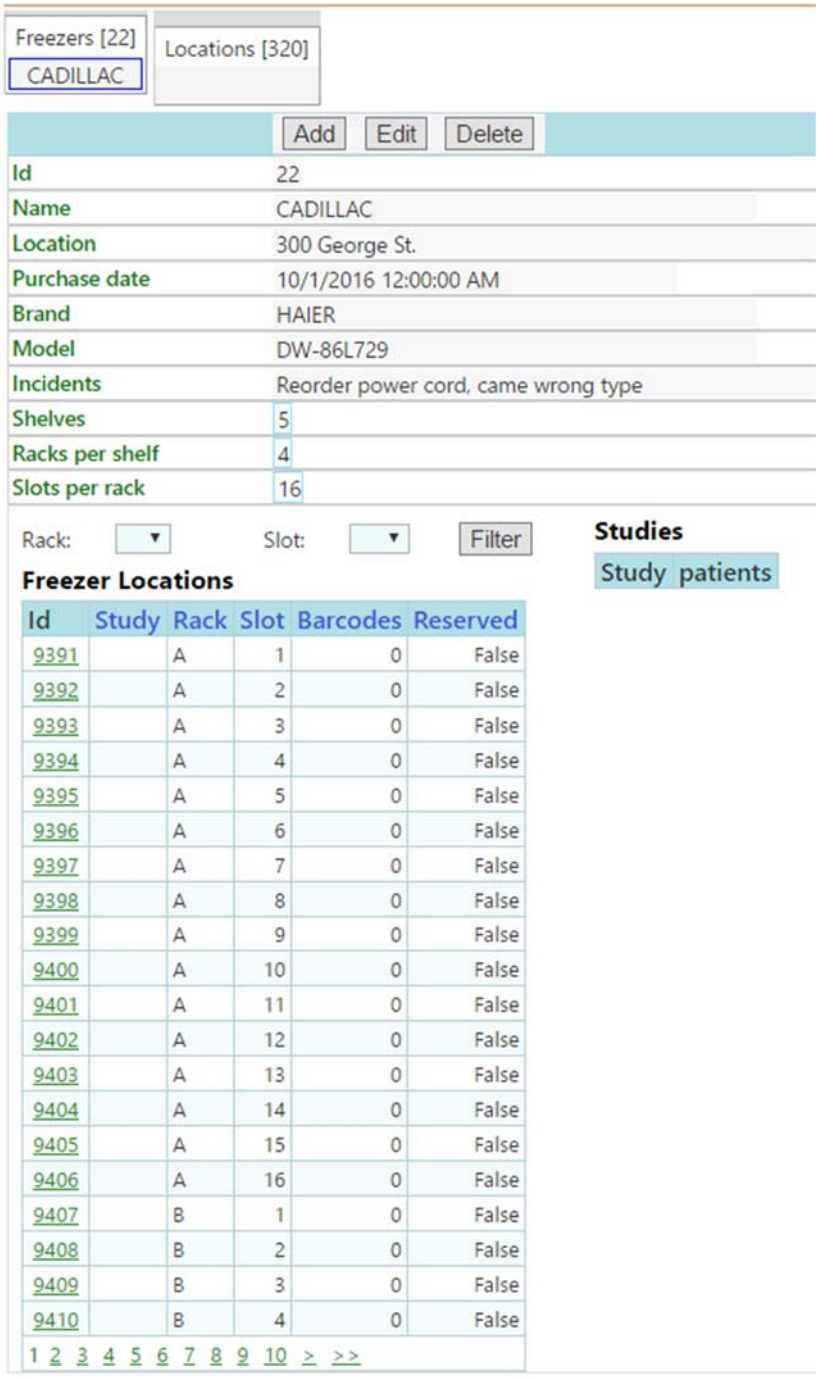
3.1 Adding Freezers.

The “New” button leads to a page to specify characteristics on a new freezer.



When finished, press update. The following image shows the information generated for the new freezer, including the freezer locations given by the internal system coordinates: Racks (A to T), Slots (1 to 16).

Rack letters are assigned by multiplying Shelves by the Racks per shelf. (4x5=20) = (A to T). When more letters are needed, the system uses a double letter nomenclature. AA, BB, ...



Freezers [22] | Locations [320]

CADILLAC

Add | Edit | Delete

Id	22
Name	CADILLAC
Location	300 George St.
Purchase date	10/1/2016 12:00:00 AM
Brand	HAIER
Model	DW-86L729
Incidents	Reorder power cord, came wrong type
Shelves	5
Racks per shelf	4
Slots per rack	16

Rack: ▾ Slot: ▾ Filter

Freezer Locations

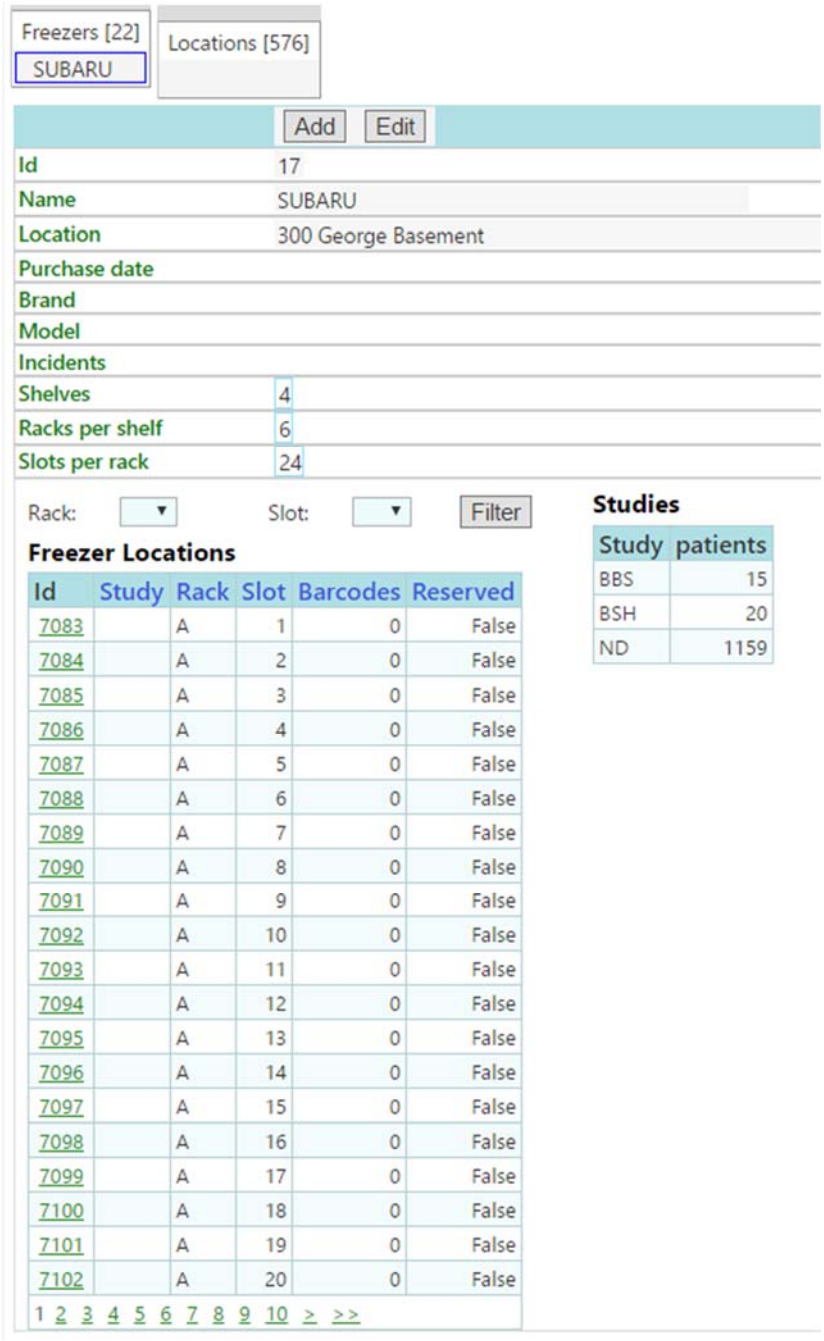
Id	Study	Rack	Slot	Barcodes	Reserved
9391		A	1	0	False
9392		A	2	0	False
9393		A	3	0	False
9394		A	4	0	False
9395		A	5	0	False
9396		A	6	0	False
9397		A	7	0	False
9398		A	8	0	False
9399		A	9	0	False
9400		A	10	0	False
9401		A	11	0	False
9402		A	12	0	False
9403		A	13	0	False
9404		A	14	0	False
9405		A	15	0	False
9406		A	16	0	False
9407		B	1	0	False
9408		B	2	0	False
9409		B	3	0	False
9410		B	4	0	False

1 2 3 4 5 6 7 8 9 10 > >>

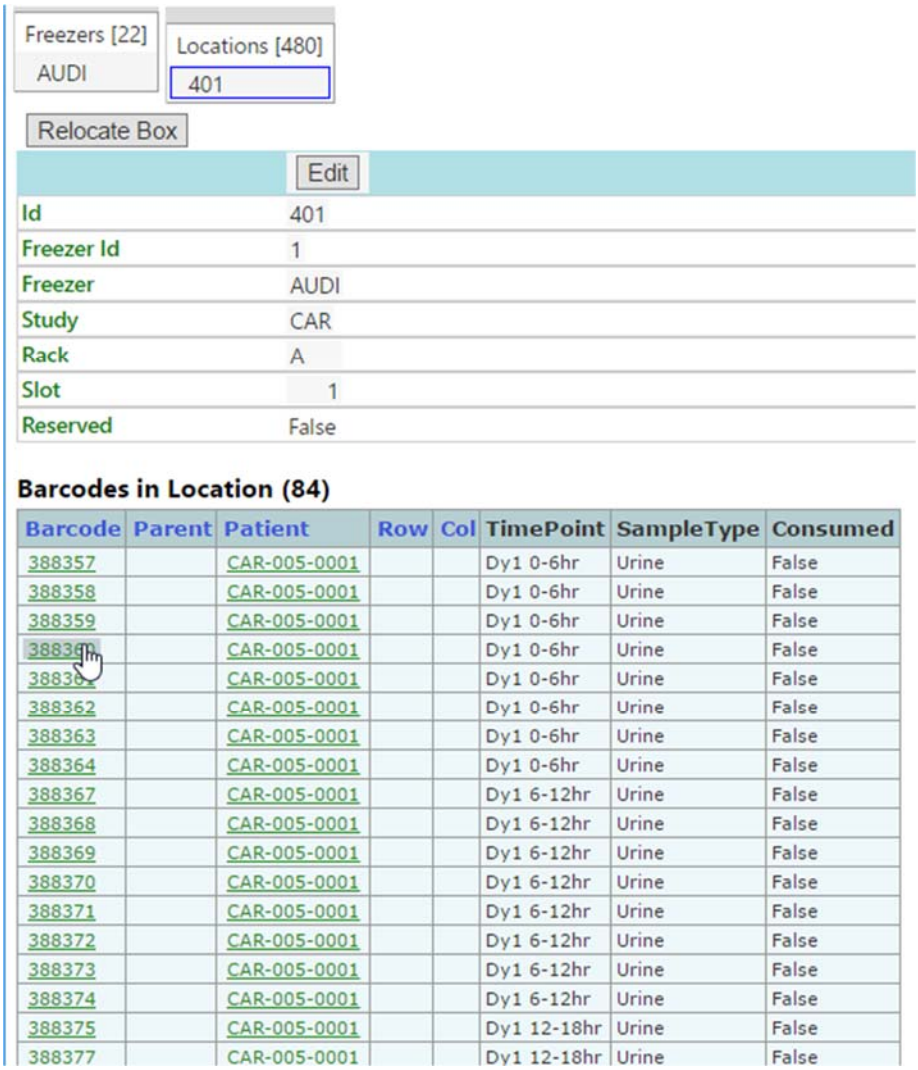
Studies

Study	patients

In a populated freezer (like the one shown below), beside the list of all freezer locations (table at the bottom left of the screen), there is a table on the right that shows the number of studies and patients in that freezer.



Clicking on any of the freezer locations will lead to a page that shows all barcodes located in the box at that location.



Each barcode and patient link leads to the details for that item.

3.2 Deleting Freezers

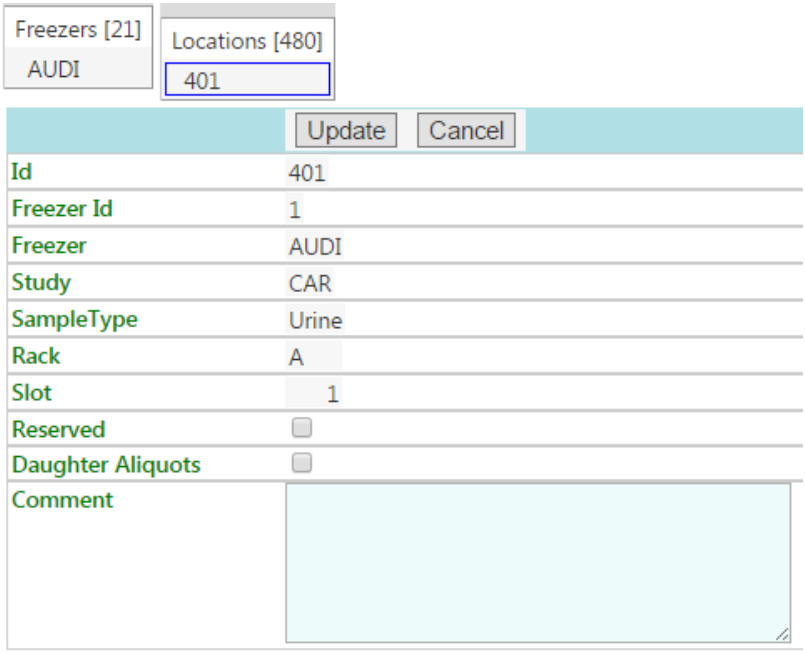
Freezers can only be deleted if they are empty. Pressing the Delete button will confirm whether or not this operation can be performed.

3.3 Freezer Location

A freezer location is a place where a box can be placed. When a freezer location is occupied by a box, that box is identified with that location ID. All freezer locations begin empty; once a box starts to fill with samples, they are listed in the Location page.

3.3.1 Reserve/Unreserve a Freezer Location and Adding Comments

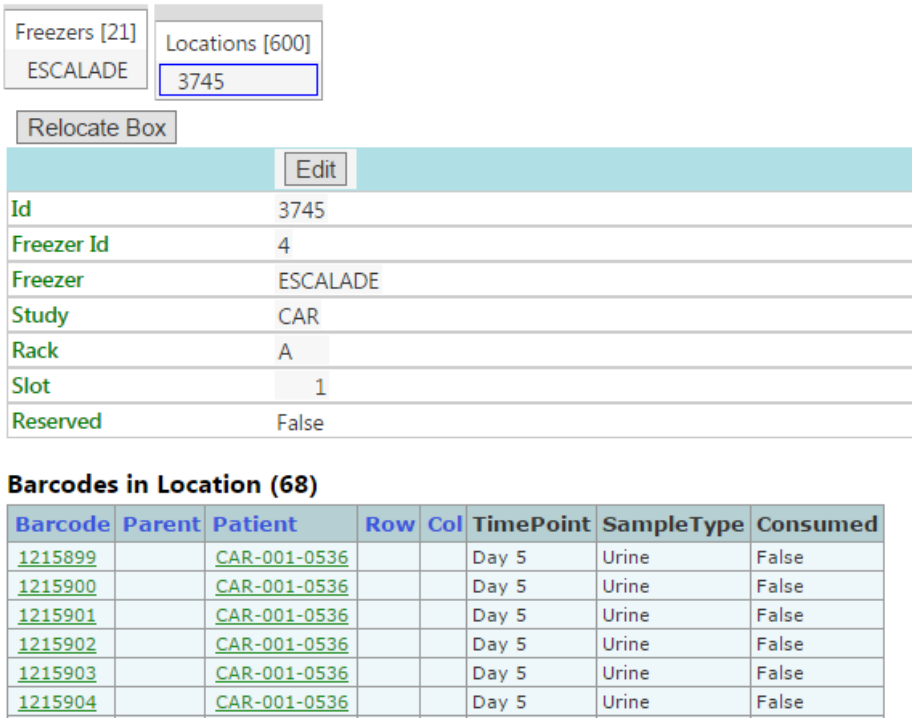
In some situations, it is necessary to reserve or free some freezer locations. This can be done by using the [Edit] button, and checking or unchecking the reserve checkbox. Additionally, you can leave free text comments on the location.



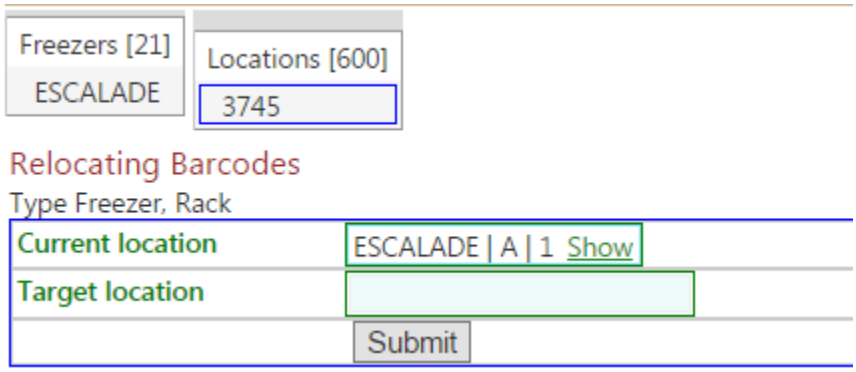
Reserved boxes and comments can be viewed in multiple reports detailed later in the manual. Reserved locations will be grayed out in most freezer reports.

3.3.2 Relocating Boxes

Whole boxes can be relocated to unfilled locations in freezers. To do so, navigate to an individual location from Freezers and click “Relocate box.”



Type in the target location and press update on the next screen.



3.4 Freezer Reports

There are five types of reports accessible from the main Freezer list page. The first three and last report can be displayed on the screen, printed (select and press Ctrl+P), or exported to excel (via an Export button on each of the reports). The Barcodes report can only be exported to Excel. Reserved spaces will be grayed out in each of these reports.

Freezers List New

Id	Name	Location	Shelves	Racks	Slots	Boxes	Locations	Reports
1	AUDI	TAC 4th Floor	5	6	16	480	480	Samples - Patients - Sampletypes - Barcodes - Comments
2	BEETLE	TAC Basement	4	5	20	400	400	Samples - Patients - Sampletypes - Barcodes - Comments
3	DAISY	300 George Basement	4	6	24	576	576	Samples - Patients - Sampletypes - Barcodes - Comments

3.4.1 Freezer Samples Report

This provides the number of samples by shelf, rack and slot.

Freezer - Total Barcodes (8/15/2016 10:26:29 AM)

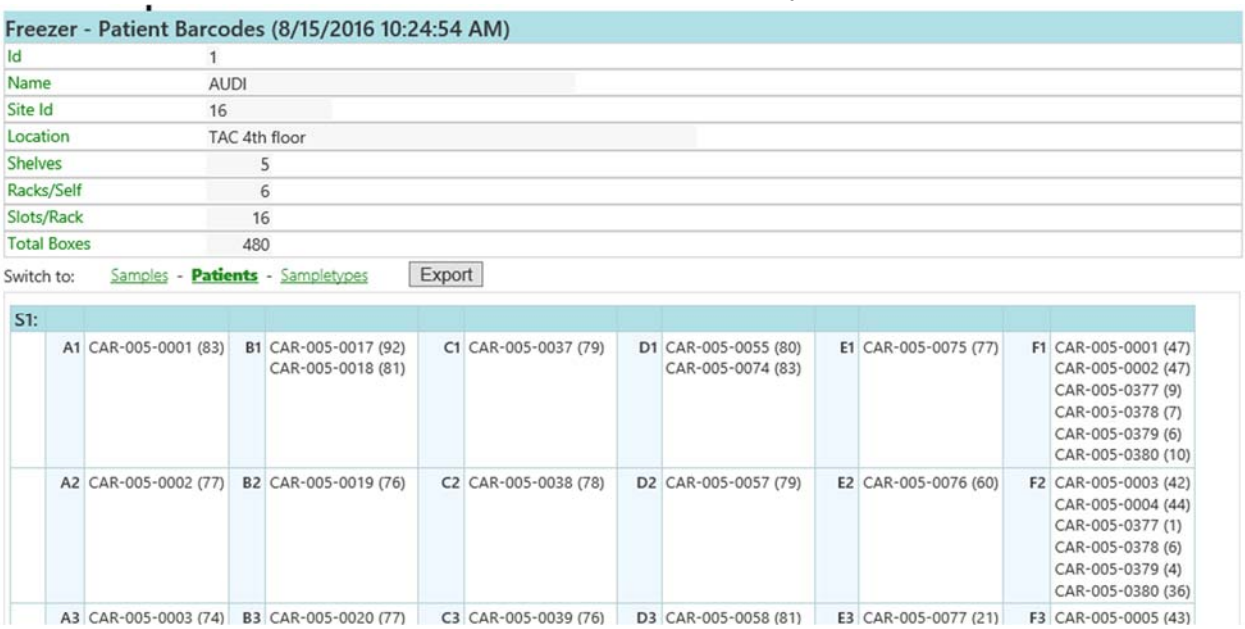
Id	1
Name	AUDI
Site Id	16
Location	TAC 4th floor
Shelves	5
Racks/Self	6
Slots/Rack	16
Total Boxes	480

Switch to: **Samples** - Patients - Sampletypes Export

S1:											
A1	83	B1	173	C1	79	D1	163	E1	77	F1	126
A2	77	B2	76	C2	78	D2	79	E2	60	F2	133
A3	74	B3	77	C3	76	D3	163	E3	44	F3	119
A4	75	B4	163	C4	164	D4	70	E4	16	F4	139
A5	77	B5	163	C5	78	D5	80	E5	28	F5	185
A6	79	B6	79	C6	81	D6	78	E6	30	F6	158
A7	80	B7	74	C7	76	D7	73	E7	49	F7	130

3.4.2 Freezer Patient Report

This provides a list of patients and their number of samples by shelf, rack and slot.



Freezer - Patient Barcodes (8/15/2016 10:24:54 AM)

Id	1
Name	AUDI
Site Id	16
Location	TAC 4th floor
Shelves	5
Racks/Self	6
Slots/Rack	16
Total Boxes	480

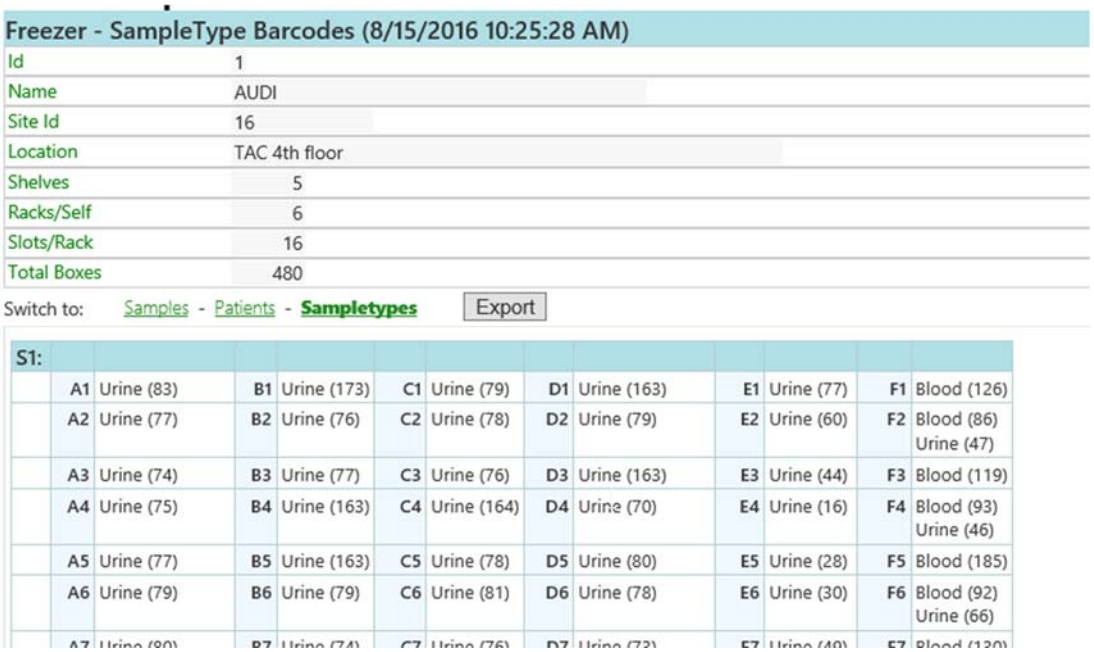
Switch to: Samples - **Patients** - Sampletypes Export

S1:

A1	CAR-005-0001 (83)	B1	CAR-005-0017 (92) CAR-005-0018 (81)	C1	CAR-005-0037 (79)	D1	CAR-005-0055 (80) CAR-005-0074 (83)	E1	CAR-005-0075 (77)	F1	CAR-005-0001 (47) CAR-005-0002 (47) CAR-005-0377 (9) CAR-005-0378 (7) CAR-005-0379 (6) CAR-005-0380 (10)
A2	CAR-005-0002 (77)	B2	CAR-005-0019 (76)	C2	CAR-005-0038 (78)	D2	CAR-005-0057 (79)	E2	CAR-005-0076 (60)	F2	CAR-005-0003 (42) CAR-005-0004 (44) CAR-005-0377 (1) CAR-005-0378 (6) CAR-005-0379 (4) CAR-005-0380 (36)
A3	CAR-005-0003 (74)	B3	CAR-005-0020 (77)	C3	CAR-005-0039 (76)	D3	CAR-005-0058 (81)	E3	CAR-005-0077 (21)	F3	CAR-005-0005 (43)

3.4.3 Freezer SampleType Report

This provides a list of sample types and their number by shelf, rack and slot.
Sample types can be color-coded by system administrators on the system configuration page.



Freezer - SampleType Barcodes (8/15/2016 10:25:28 AM)

Id	1
Name	AUDI
Site Id	16
Location	TAC 4th floor
Shelves	5
Racks/Self	6
Slots/Rack	16
Total Boxes	480

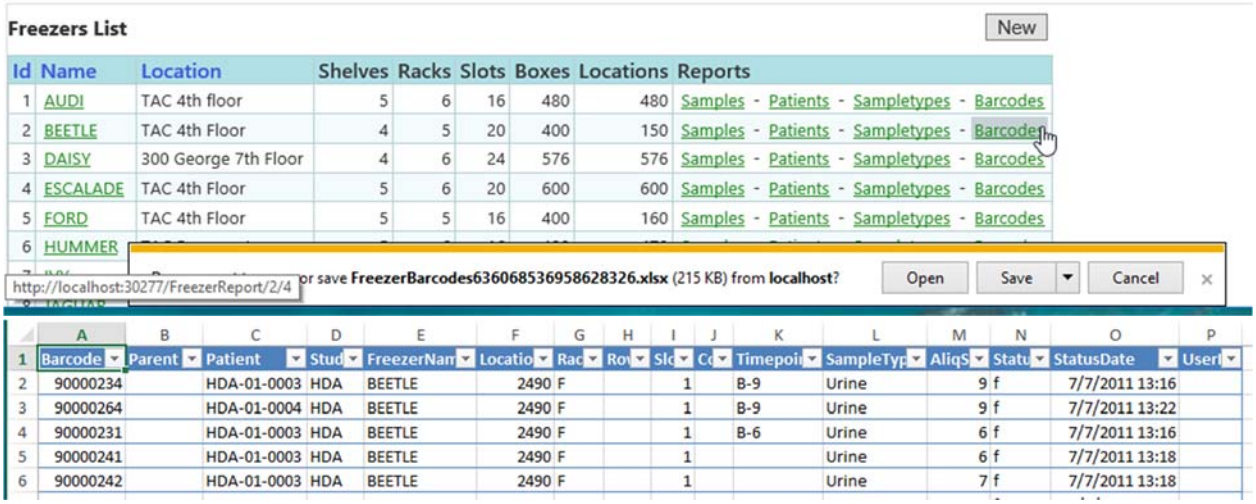
Switch to: Samples - Patients - **Sampletypes** Export

S1:

A1	Urine (83)	B1	Urine (173)	C1	Urine (79)	D1	Urine (163)	E1	Urine (77)	F1	Blood (126)
A2	Urine (77)	B2	Urine (76)	C2	Urine (78)	D2	Urine (79)	E2	Urine (60)	F2	Blood (86) Urine (47)
A3	Urine (74)	B3	Urine (77)	C3	Urine (76)	D3	Urine (163)	E3	Urine (44)	F3	Blood (119)
A4	Urine (75)	B4	Urine (163)	C4	Urine (164)	D4	Urine (70)	E4	Urine (16)	F4	Blood (93) Urine (46)
A5	Urine (77)	B5	Urine (163)	C5	Urine (78)	D5	Urine (80)	E5	Urine (28)	F5	Blood (185)
A6	Urine (79)	B6	Urine (79)	C6	Urine (81)	D6	Urine (78)	E6	Urine (30)	F6	Blood (92) Urine (66)
A7	Urine (80)	B7	Urine (74)	C7	Urine (76)	D7	Urine (73)	E7	Urine (40)	F7	Blood (130)

3.4.4 Freezer Barcodes Report

This report provides details of all samples in a single freezer. Due to its size, it can only be downloaded.



Freezers List

New

Id	Name	Location	Shelves	Racks	Slots	Boxes	Locations	Reports
1	AUDI	TAC 4th floor	5	6	16	480	480	Samples - Patients - Sampletypes - Barcodes
2	BEETLE	TAC 4th Floor	4	5	20	400	150	Samples - Patients - Sampletypes - Barcodes
3	DAISY	300 George 7th Floor	4	6	24	576	576	Samples - Patients - Sampletypes - Barcodes
4	ESCALADE	TAC 4th Floor	5	6	20	600	600	Samples - Patients - Sampletypes - Barcodes
5	FORD	TAC 4th Floor	5	5	16	400	160	Samples - Patients - Sampletypes - Barcodes
6	HUMMER							

http://localhost:30277/FreezerReport/2/4

or save **FreezerBarcodes636068536958628326.xlsx** (215 KB) from **localhost**?

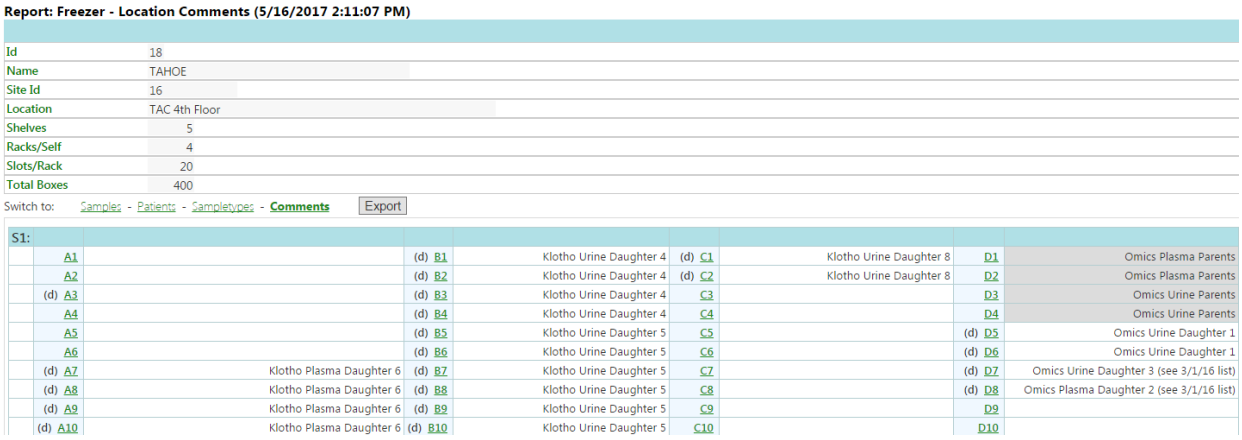
Open | Save | Cancel

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Barcode	Parent	Patient	Stud	FreezerNam	Locatio	Rac	Ro	Slo	C	Timepoi	SampleTyp	AliqS	Statu	StatusDate	User
2	90000234		HDA-01-0003	HDA	BEETLE	2490	F		1		B-9	Urine	9	f	7/7/2011 13:16	
3	90000264		HDA-01-0004	HDA	BEETLE	2490	F		1		B-9	Urine	9	f	7/7/2011 13:22	
4	90000231		HDA-01-0003	HDA	BEETLE	2490	F		1		B-6	Urine	6	f	7/7/2011 13:16	
5	90000241		HDA-01-0003	HDA	BEETLE	2490	F		1			Urine	6	f	7/7/2011 13:18	
6	90000242		HDA-01-0003	HDA	BEETLE	2490	F		1			Urine	7	f	7/7/2011 13:18	

This report can be filtered by each characteristic of a sample, making it the master report for a freezer.

3.4.5 Freezer Comments Report

This report displays all the comments on locations within a freezer. You can use this to find subgroups which were pulled from a study (ex. Klotho CAR samples) and to also track shipments which were returned but not rescanned into



Report: Freezer - Location Comments (5/16/2017 2:11:07 PM)

Id	18
Name	TAHOE
Site Id	16
Location	TAC 4th Floor
Shelves	5
Racks/Self	4
Slots/Rack	20
Total Boxes	400

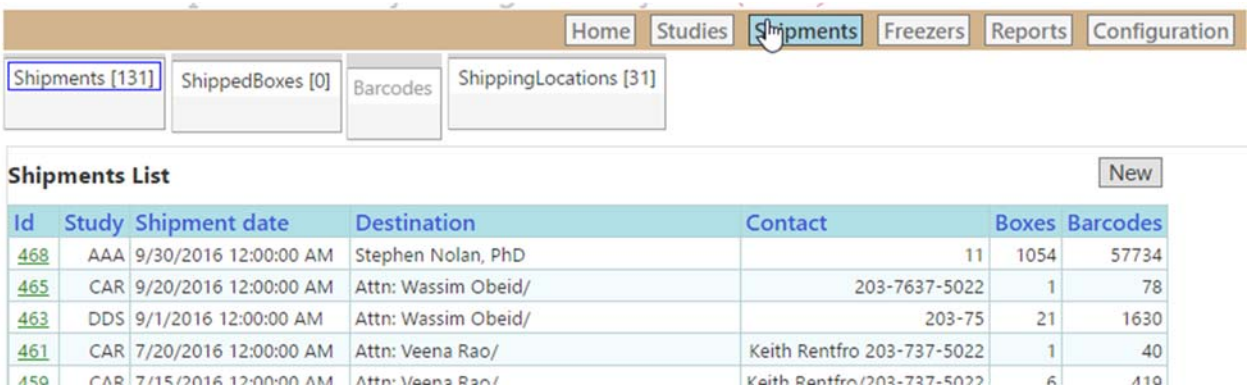
Switch to: Samples - Patients - Sampletypes - **Comments** Export

S1:

	A1			(d) B1	Klotho Urine Daughter 4	(d) C1	Klotho Urine Daughter 8		D1		Omics Plasma Parents
	A2			(d) B2	Klotho Urine Daughter 4	(d) C2	Klotho Urine Daughter 8		D2		Omics Plasma Parents
	(d) A3			(d) B3	Klotho Urine Daughter 4	C3			D3		Omics Urine Parents
	A4			(d) B4	Klotho Urine Daughter 4	C4			D4		Omics Urine Parents
	A5			(d) B5	Klotho Urine Daughter 5	C5			(d) D5		Omics Urine Daughter 1
	A6			(d) B6	Klotho Urine Daughter 5	C6			(d) D6		Omics Urine Daughter 1
	(d) A7		Klotho Plasma Daughter 6	(d) B7	Klotho Urine Daughter 5	C7			(d) D7		Omics Urine Daughter 3 (see 3/1/16 list)
	(d) A8		Klotho Plasma Daughter 6	(d) B8	Klotho Urine Daughter 5	C8			(d) D8		Omics Plasma Daughter 2 (see 3/1/16 list)
	(d) A9		Klotho Plasma Daughter 6	(d) B9	Klotho Urine Daughter 5	C9			D9		
	(d) A10		Klotho Plasma Daughter 6	(d) B10	Klotho Urine Daughter 5	C10			D10		

4 Shipments

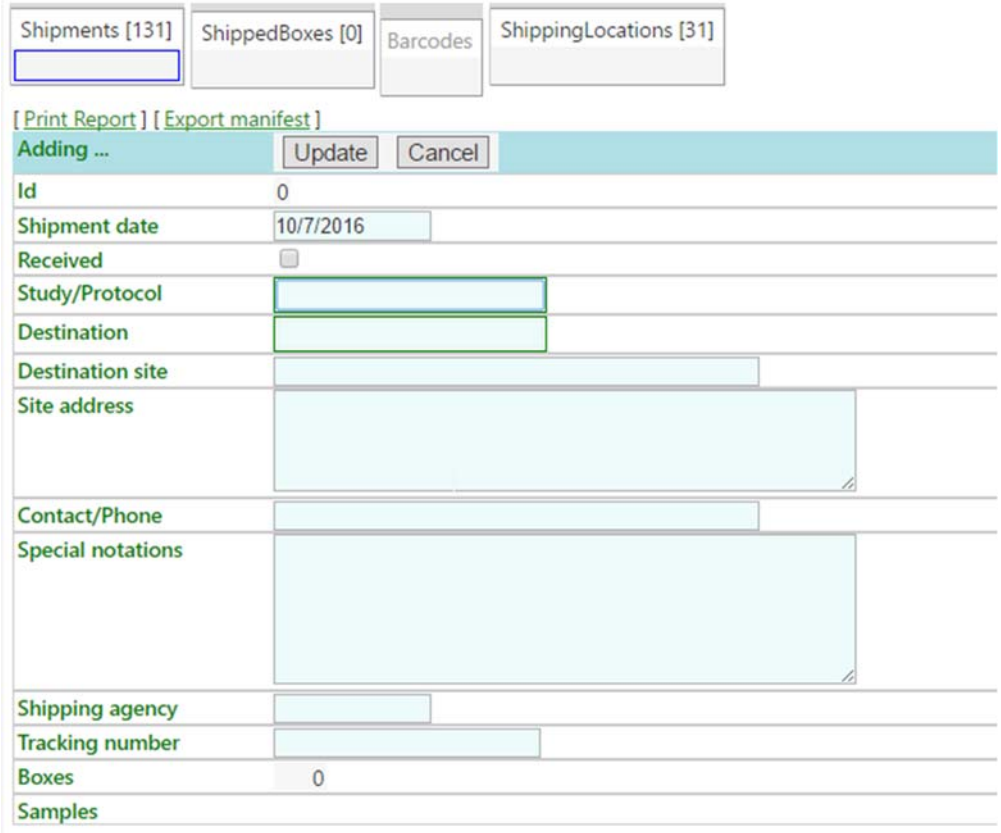
From the main menu select “Shipments”, and a list of all shipments recorded by the system is presented in descending chronological order. The list can be sorted by each of the columns when a header is clicked.



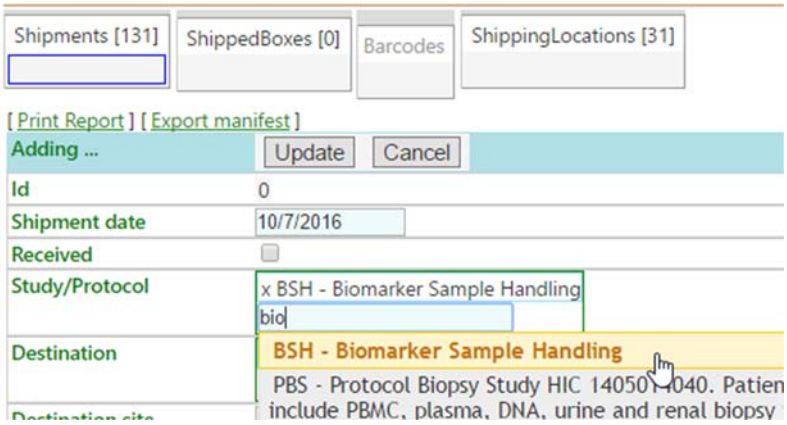
Id	Study	Shipment date	Destination	Contact	Boxes	Barcodes
468	AAA	9/30/2016 12:00:00 AM	Stephen Nolan, PhD	11	1054	57734
465	CAR	9/20/2016 12:00:00 AM	Attn: Wassim Obeid/	203-7637-5022	1	78
463	DDS	9/1/2016 12:00:00 AM	Attn: Wassim Obeid/	203-75	21	1630
461	CAR	7/20/2016 12:00:00 AM	Attn: Veena Rao/	Keith Rentfro 203-737-5022	1	40
459	CAR	7/15/2016 12:00:00 AM	Attn: Veena Rao/	Keith Rentfro/203-737-5022	6	419

4.1 Creating a New Shipment

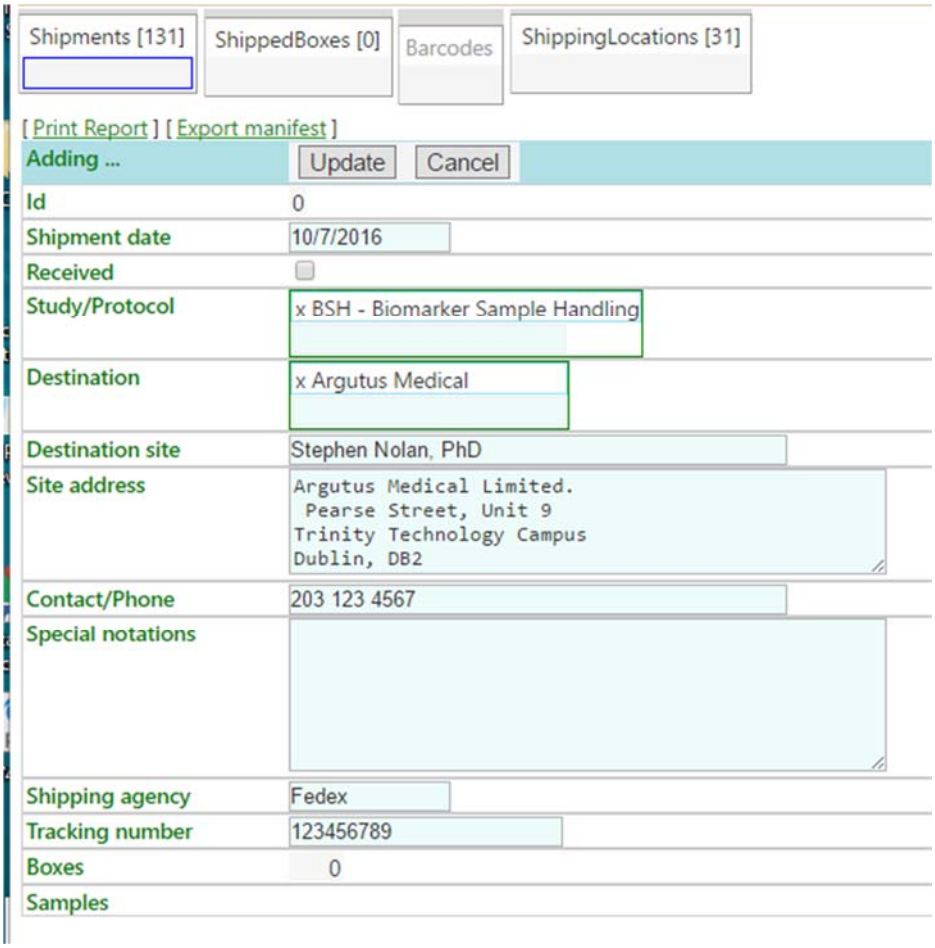
Study administrators are allowed to create a new shipment. Press the “New” button. The next form shows the required information.



The green framed boxes, “study” and “destination,” are auto-populated lists that are filled with filtered choices when you type more than 3 characters contained in those categories. Type in three spaces to show all choices.

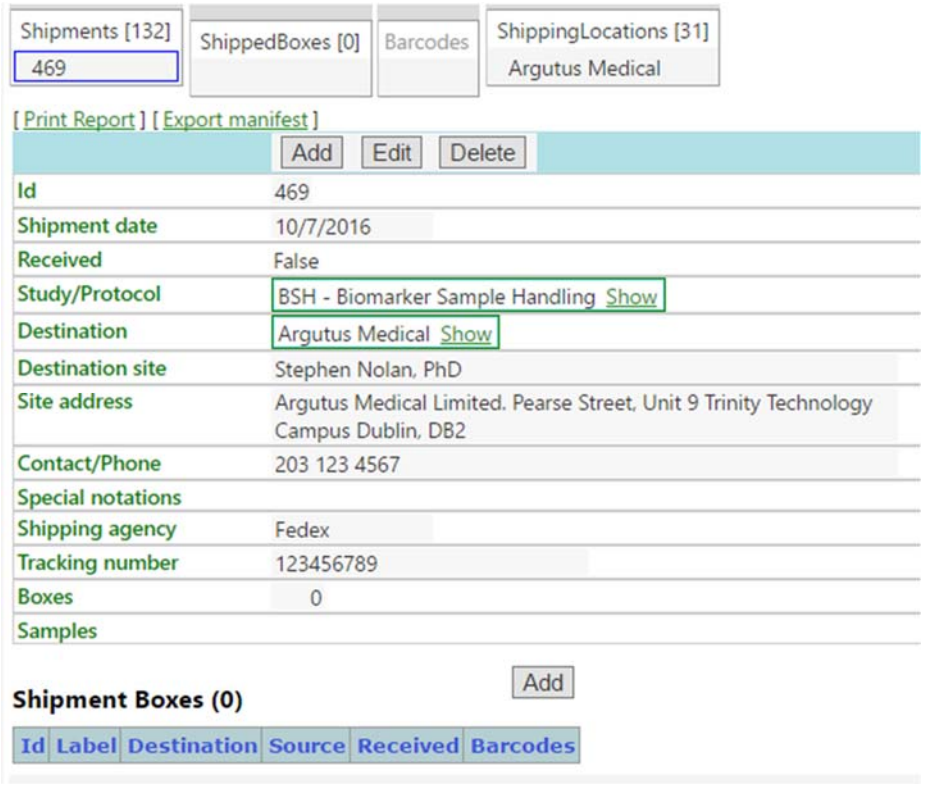


After selecting “Destination”, the destination site and site address are auto populated. Change the information if necessary. Changes here will not affect the Destination site information and will be specific to this shipment. Finish the rest of the fields and press “Update.”

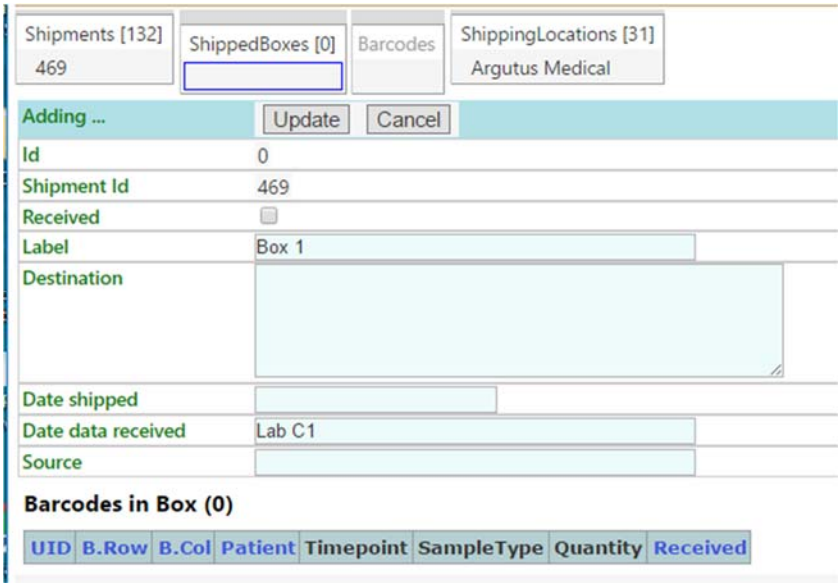


The new shipment information will be confirmed on the next page. Note the new Shipment ID under the shipments breadcrumbs bar.

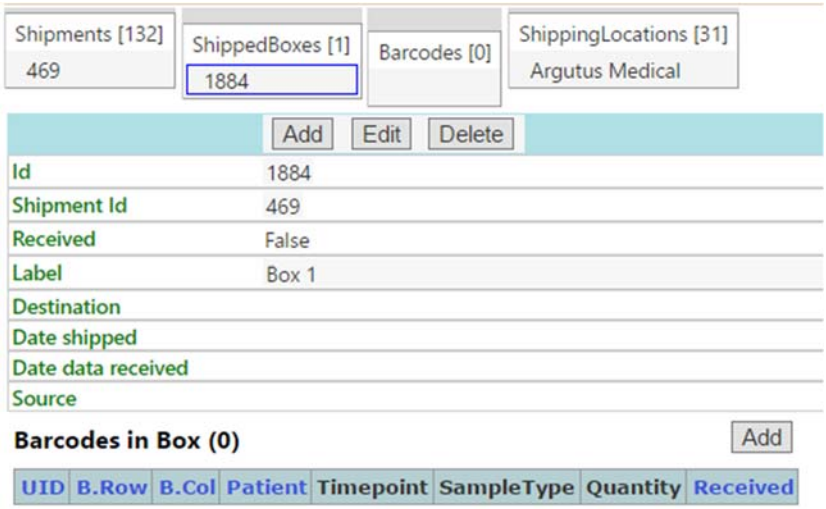
To add shipment boxes, press the “Add” button.



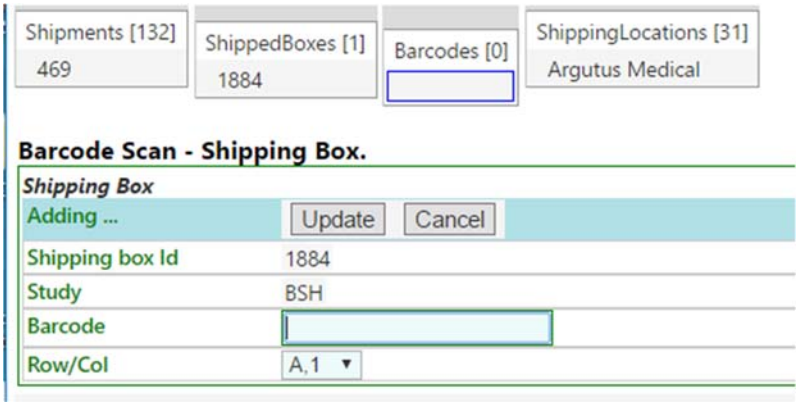
Enter information related to the box and click “Update.” The new shipping box will be generated.



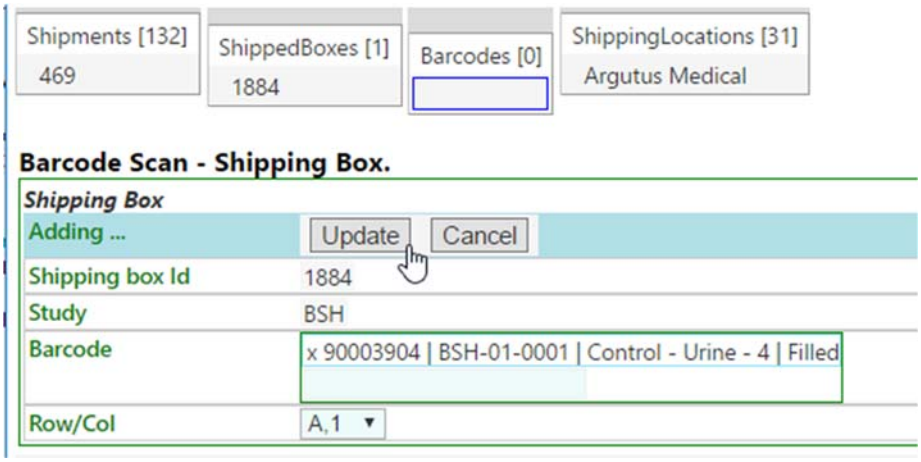
Click on the “Add” button to start scanning samples to be shipped.



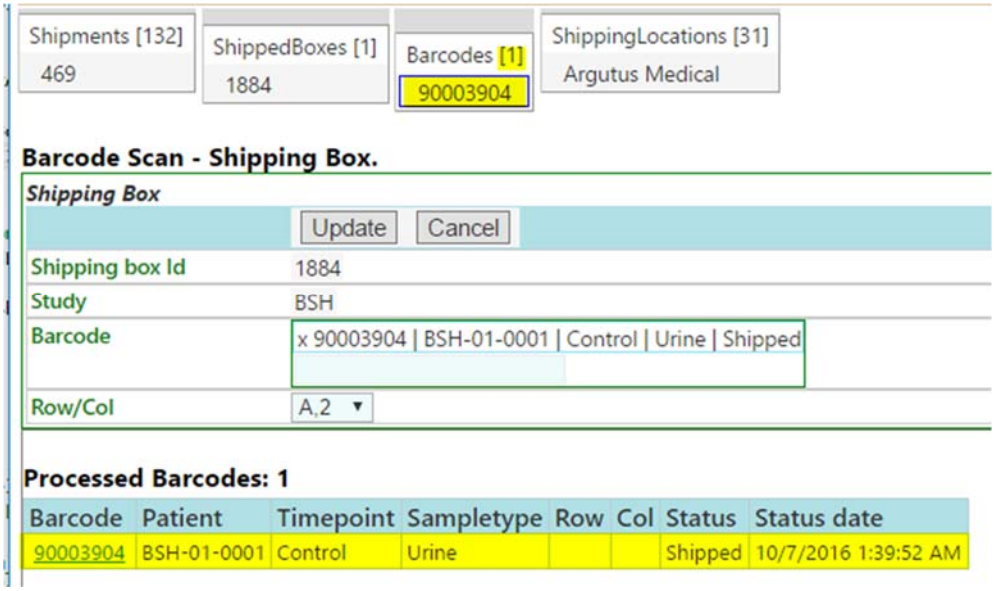
During a shipping scan, note the number of barcodes in that box. The system will automatically suggest the Row/Col location of the sample.



Note that only samples from the study specified in the shipment entry with a filled status will be allowed to be selected. If a scanner was used, a valid barcode will be automatically selected and the cursor advanced to the update button. Click “Update” or hit the [Enter] key when done.



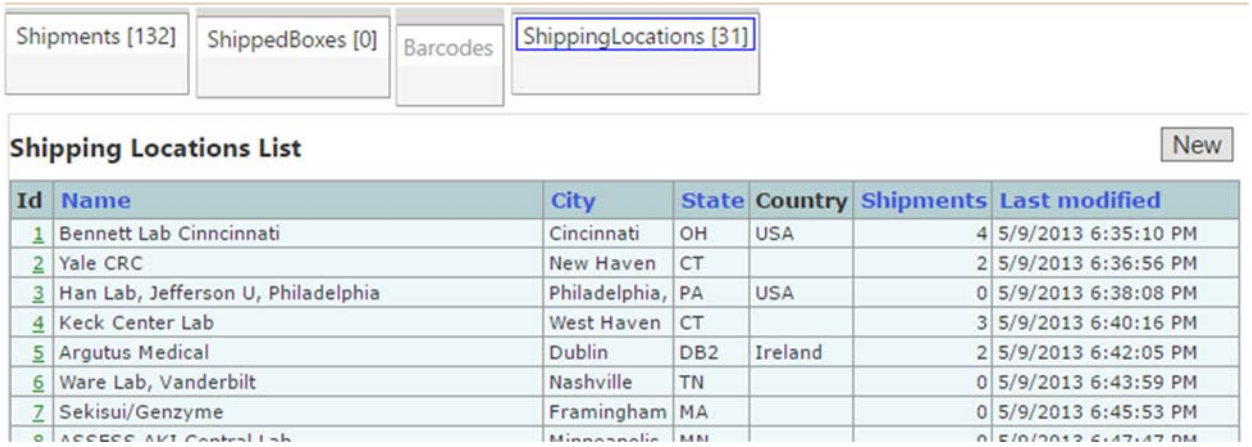
The next screen shows confirmation of the previous scan (see highlighted “processed barcode” table below) and the updated number of barcodes (from 0 to 1) in the shipped box. It also automatically advances to the next Row/Col position “A2” in the box, for the next sample to be scanned. Continue repeating this step until that box is filled.



If more boxes are needed, click on “ShippedBoxes” in the breadcrumb menu, to show the list. Click “New” for a new box.

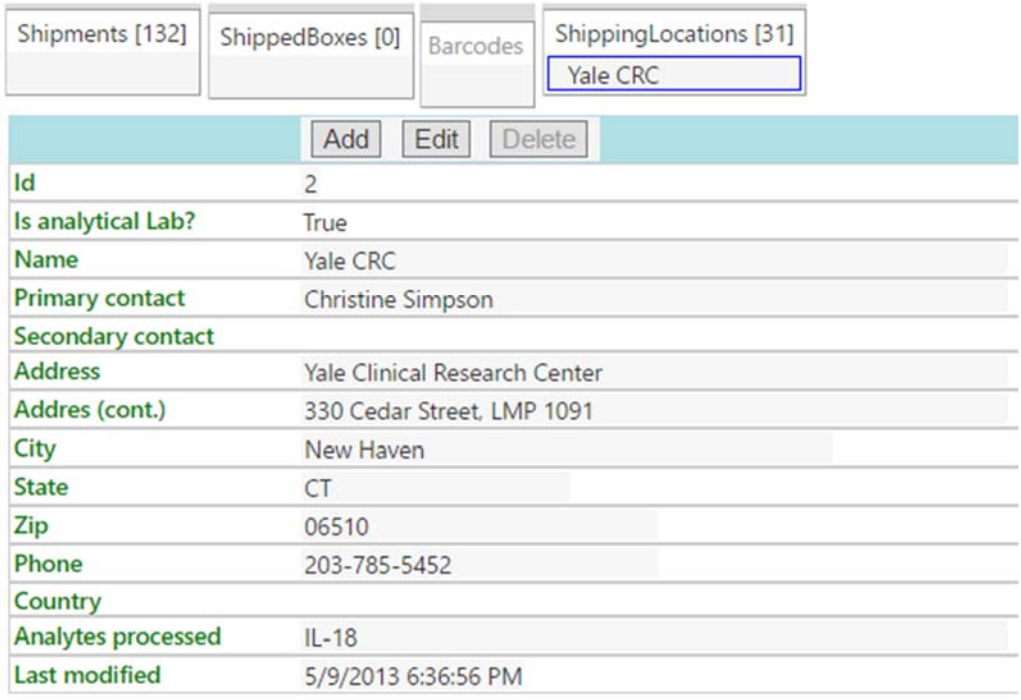
4.2 Shipment Locations

From the shipments breadcrumbs menu, select “ShippingLocations” to show all registered locations.



Id	Name	City	State	Country	Shipments	Last modified
1	Bennett Lab Cinncinnati	Cincinnati	OH	USA	4	5/9/2013 6:35:10 PM
2	Yale CRC	New Haven	CT		2	5/9/2013 6:36:56 PM
3	Han Lab, Jefferson U, Philadelphia	Philadelphia,	PA	USA	0	5/9/2013 6:38:08 PM
4	Keck Center Lab	West Haven	CT		3	5/9/2013 6:40:16 PM
5	Argutus Medical	Dublin	DB2	Ireland	2	5/9/2013 6:42:05 PM
6	Ware Lab, Vanderbilt	Nashville	TN		0	5/9/2013 6:43:59 PM
7	Sekisui/Genzyme	Framingham	MA		0	5/9/2013 6:45:53 PM

Click on “New” to enter a new shipment location or select an ID to modify an existing entry. The shipment location detail page has a list of all shipments sent out to that location.



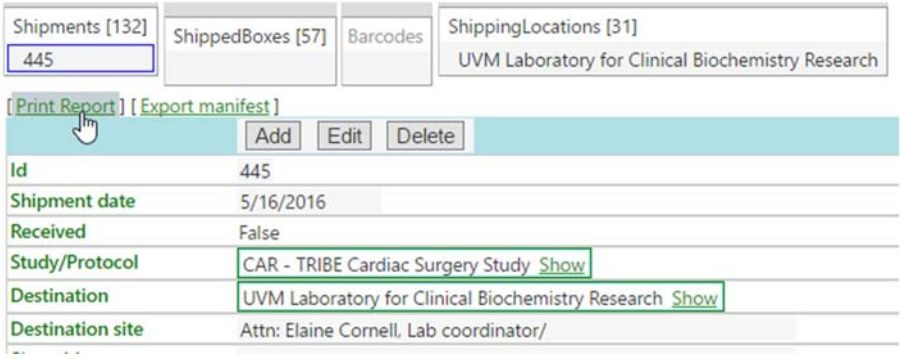
Id	2
Is analytical Lab?	True
Name	Yale CRC
Primary contact	Christine Simpson
Secondary contact	
Address	Yale Clinical Research Center
Addres (cont.)	330 Cedar Street, LMP 1091
City	New Haven
State	CT
Zip	06510
Phone	203-785-5452
Country	
Analytes processed	IL-18
Last modified	5/9/2013 6:36:56 PM

Shipments

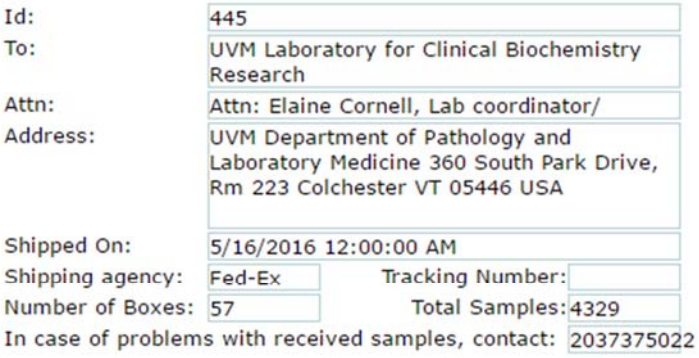
Id	Date	Agency	Tracking	Contact	Boxes	Received
120	8/25/2014 12:00:00 AM	Courier		Rowena 203-737-5022	7	False
321	7/9/2015 12:00:00 AM	Courier		203-737-5022	2	False

4.3 Shipment Report

From the shipment details page, click on “Print Report”, or “Export manifest” to obtain an excel file with the details.



A print ready page is then generated.



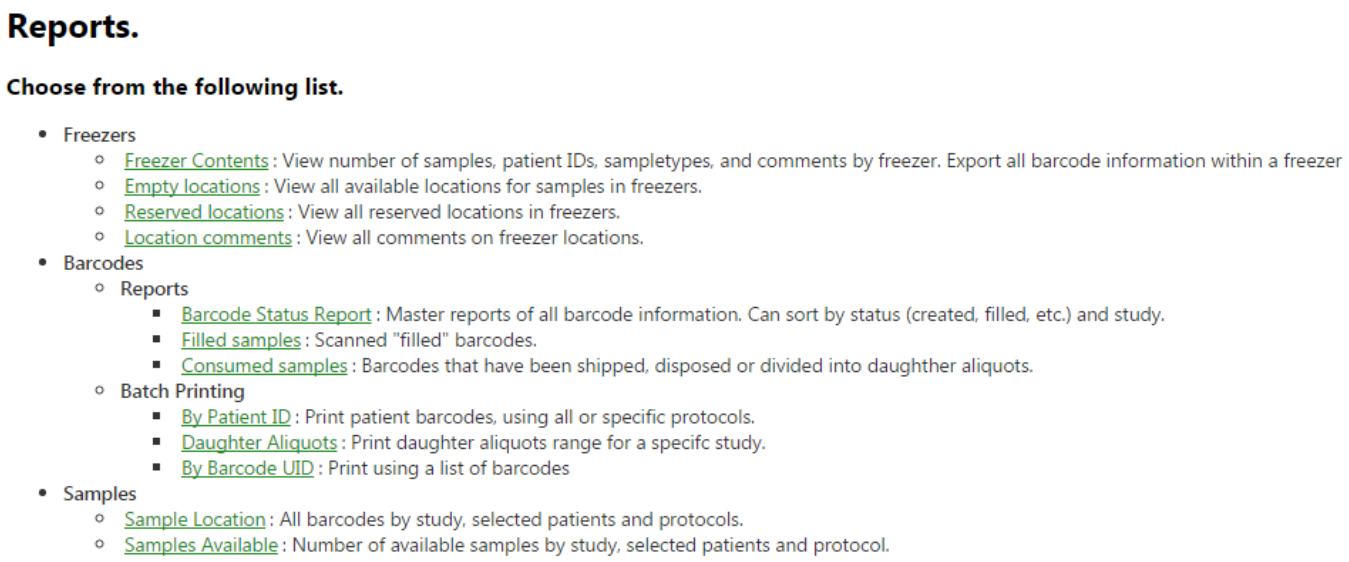
Box: 1794 Vermont Pull Box 1 SampleTypes: Blood , Plasma ,

Ship Cnt	Box Cnt	Row	Col	Barcode	Parent	Patient ID	Timepoint	Sampletype	Sequence
1	1	B	1	252254		CAR-001-0002	Base	Plasma	
2	2	B	2	262039		CAR-001-0002	Day 1	Blood	
3	3	B	3	262094		CAR-001-0002	Day 2	Blood	
4	4	B	4	263625		CAR-001-0003	Base	Blood	
5	5	B	5	264888		CAR-001-0003	Day 1	Blood	
6	6	B	6	264942		CAR-001-0003	Day 2	Blood	
7	7	B	7	261496		CAR-001-0004	Base	Blood	
8	8	B	8	265426		CAR-001-0004	Day 1	Blood	
9	9	B	9	265480		CAR-001-0004	Day 2	Blood	
10	10	B	10	306970		CAR-001-0014	Base	Blood	
11	11	C	1	313081		CAR-001-0014	Day 1	Blood	
12	12	C	2	313135		CAR-001-0014	Day 2	Blood	
13	13	C	3	315384		CAR-001-0017	Base	Blood	

This manifest should be verified against the shipment contents by the receiving party.

5 Reports

Besides providing individual context-specific reports on the sections covered above, there is a report section that summarizes and provides links to them.



Reports.

Choose from the following list.

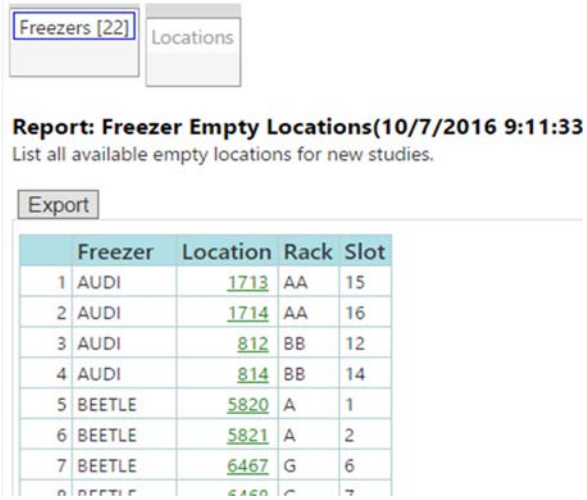
- Freezers
  - Freezer Contents : View number of samples, patient IDs, sampletypes, and comments by freezer. Export all barcode information within a freezer
  - Empty locations : View all available locations for samples in freezers.
  - Reserved locations : View all reserved locations in freezers.
  - Location comments : View all comments on freezer locations.
- Barcodes
  - Reports
    - Barcode Status Report : Master reports of all barcode information. Can sort by status (created, filled, etc.) and study.
    - Filled samples : Scanned "filled" barcodes.
    - Consumed samples : Barcodes that have been shipped, disposed or divided into daughther aliquots.
  - Batch Printing
    - By Patient ID : Print patient barcodes, using all or specific protocols.
    - Daughter Aliquots : Print daughter aliquots range for a specifc study.
    - By Barcode UID : Print using a list of barcodes
- Samples
  - Sample Location : All barcodes by study, selected patients and protocols.
  - Samples Available : Number of available samples by study, selected patients and protocol.

5.1 Freezer Location

This links to the freezers main page where several reports (explained in the freezer section) can be selected.

5.1.1 Freezer Empty Locations

This report shows all available freezer locations where new boxes can be placed.



Freezers [22] Locations

Report: Freezer Empty Locations(10/7/2016 9:11:33

List all available empty locations for new studies.

Export

	Freezer	Location	Rack	Slot
1	AUDI	1713	AA	15
2	AUDI	1714	AA	16
3	AUDI	812	BB	12
4	AUDI	814	BB	14
5	BEETLE	5820	A	1
6	BEETLE	5821	A	2
7	BEETLE	6467	G	6

5.1.2 Freezer Reserved Locations

This shows all freezer locations that are reserved and cannot be used for storing new samples.

Report: Freezer Reserved Locations (10/7/2016 9:16:40 AM)

List of all freezer reserved locations.

Export

	Freezer	Location	Rack	Slot
1	BEETLE	5821	A	2
2	TAHOE	3714	A	2

5.1.3 Location Comments

This displays all the locations which have a comment attached, so that they are searchable.

Report: Location Comments (5/22/2017 9:36:22 AM)

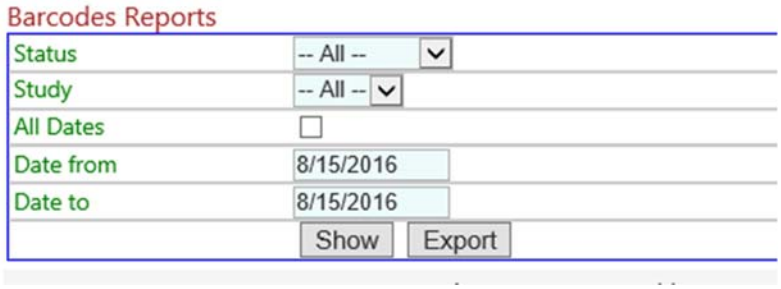
List of all freezer location's comments.

Export

	Freezer	Location	Rack	Slot	Comment
1	BEETLE	5820	A	1	Somlo
2	TAHOE	3719	A	7	Klotho Plasma Daughter 6
3	TAHOE	3720	A	8	Klotho Plasma Daughter 6

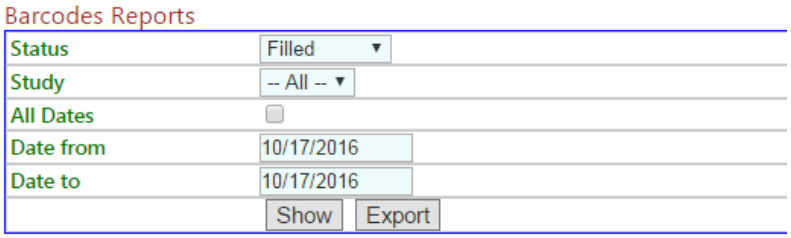
5.2 Barcode Status Report

These reports allow you to print all barcodes for any given status, study, and/or date range of the barcode status. Use the pull down controls to select values for those parameters. These reports can either be printed or exported to a downloadable excel file.



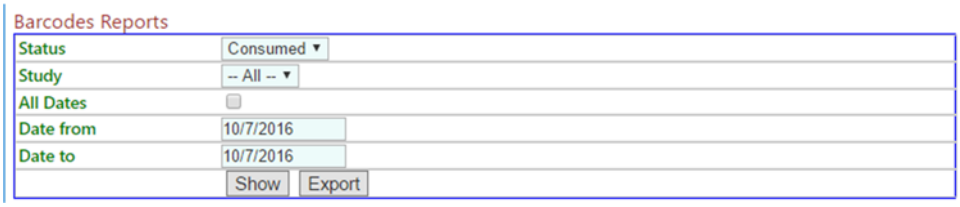
5.2.1 Scanned Samples (Barcodes Report)

This report uses the same form as the Barcodes Report, with a preselected status.



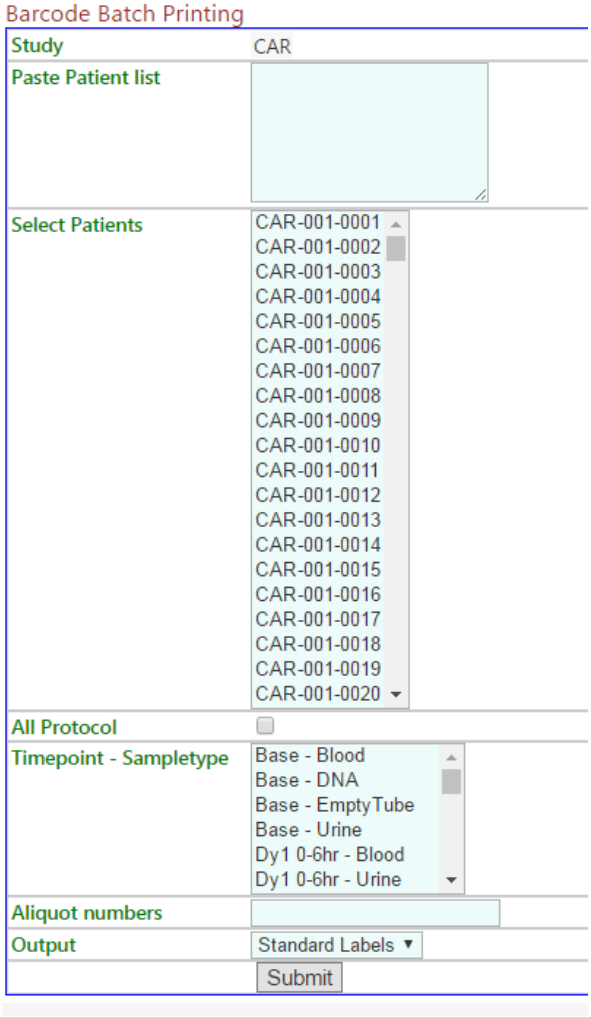
5.2.2 Consumed Samples (Barcodes Report)

This report uses the same form as the Barcodes Report, with a preselected status.



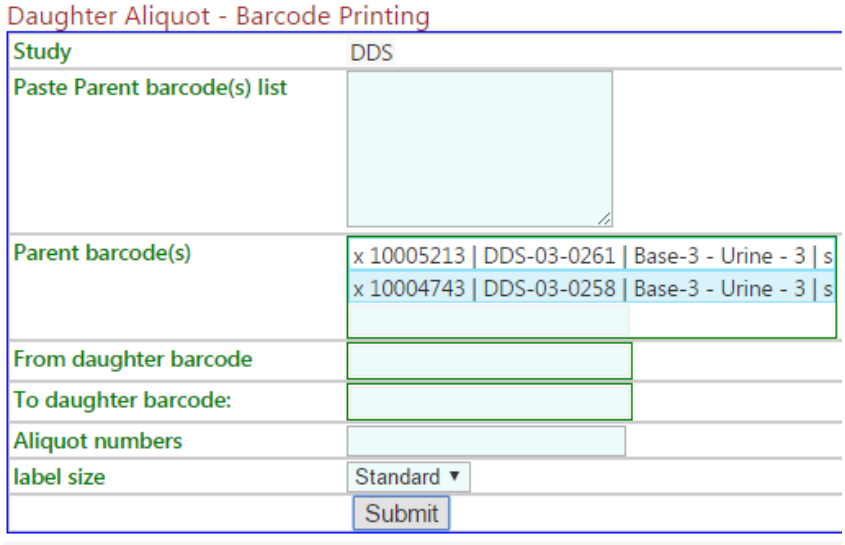
5.3 Barcode Batch Printing

This report allows you to print a batch of barcodes for a given study. Select the patients and other characteristics of the barcodes you wish to print.



5.4 Daughter Aliquot Printout

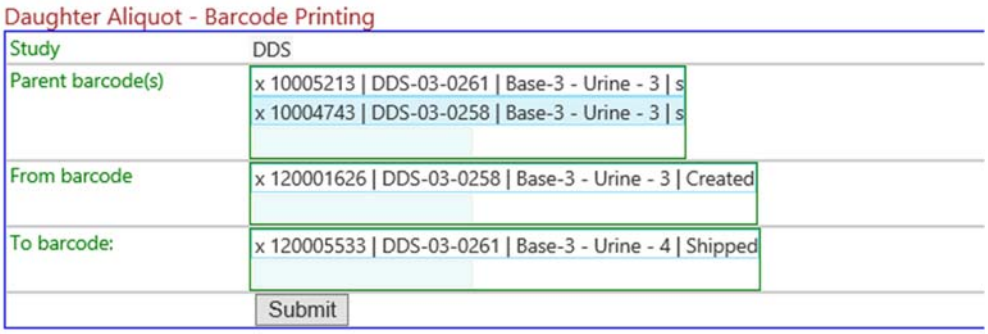
This report prints only daughter aliquots for either a given set of parents and/or a barcode range. Enter parent barcode(s):



And then we get (8) daughter samples:

You may also paste parent barcodes separated by hard returns in the appropriate box instead of scanning each. Additionally, you may specify which aliquot you want in “Aliquot numbers,” and separate them by commas. The final option is to print labels in the smaller format which fit on Eppendorf tubes.

If you add a range filter:

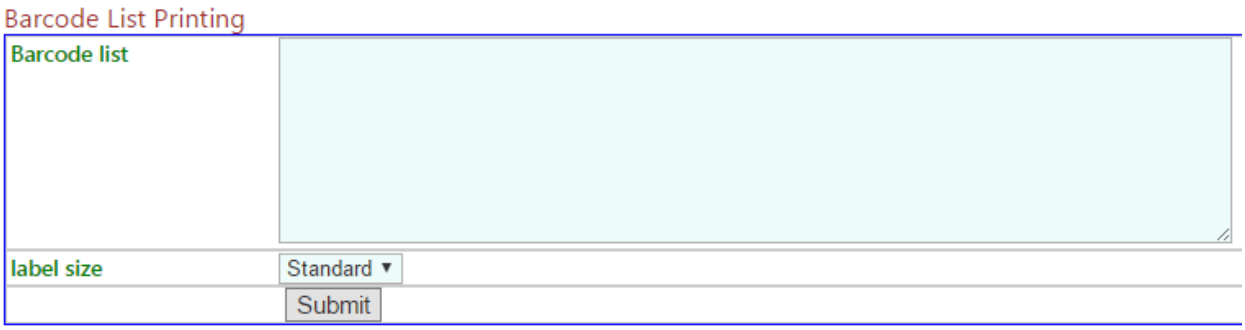


You get a subset.

To use a Barcode From - Barcode To, we do not need a range filter.

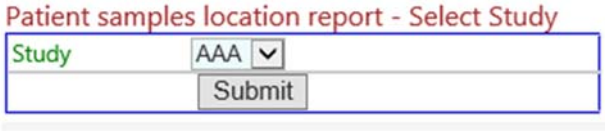
5.5 Print Barcodes by UID

If you know which barcodes you need to print by UID, you can use this module which will allow you to paste a list of UIDs separated by hard returns.

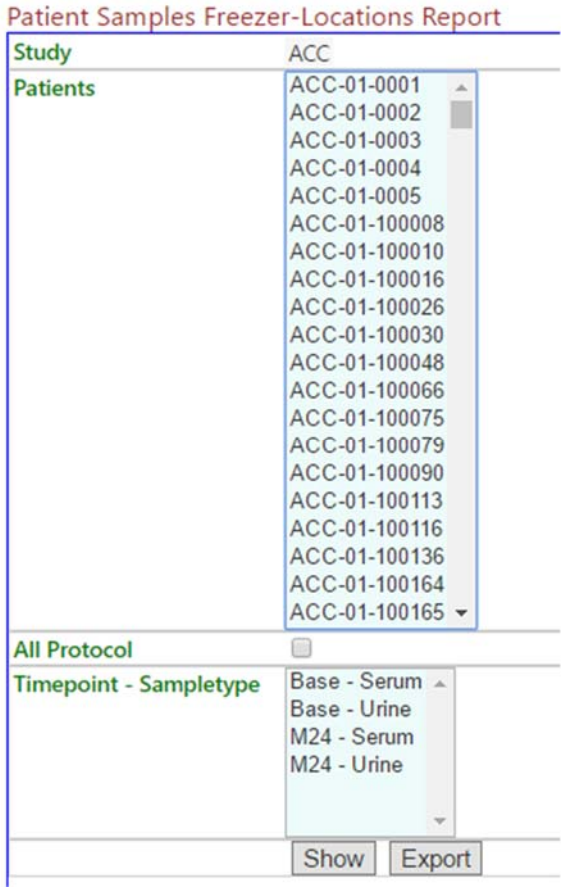


5.6 Sample Locations

This report presents all sample freezer locations for one or more patients.
Upon opening the report, select the study.



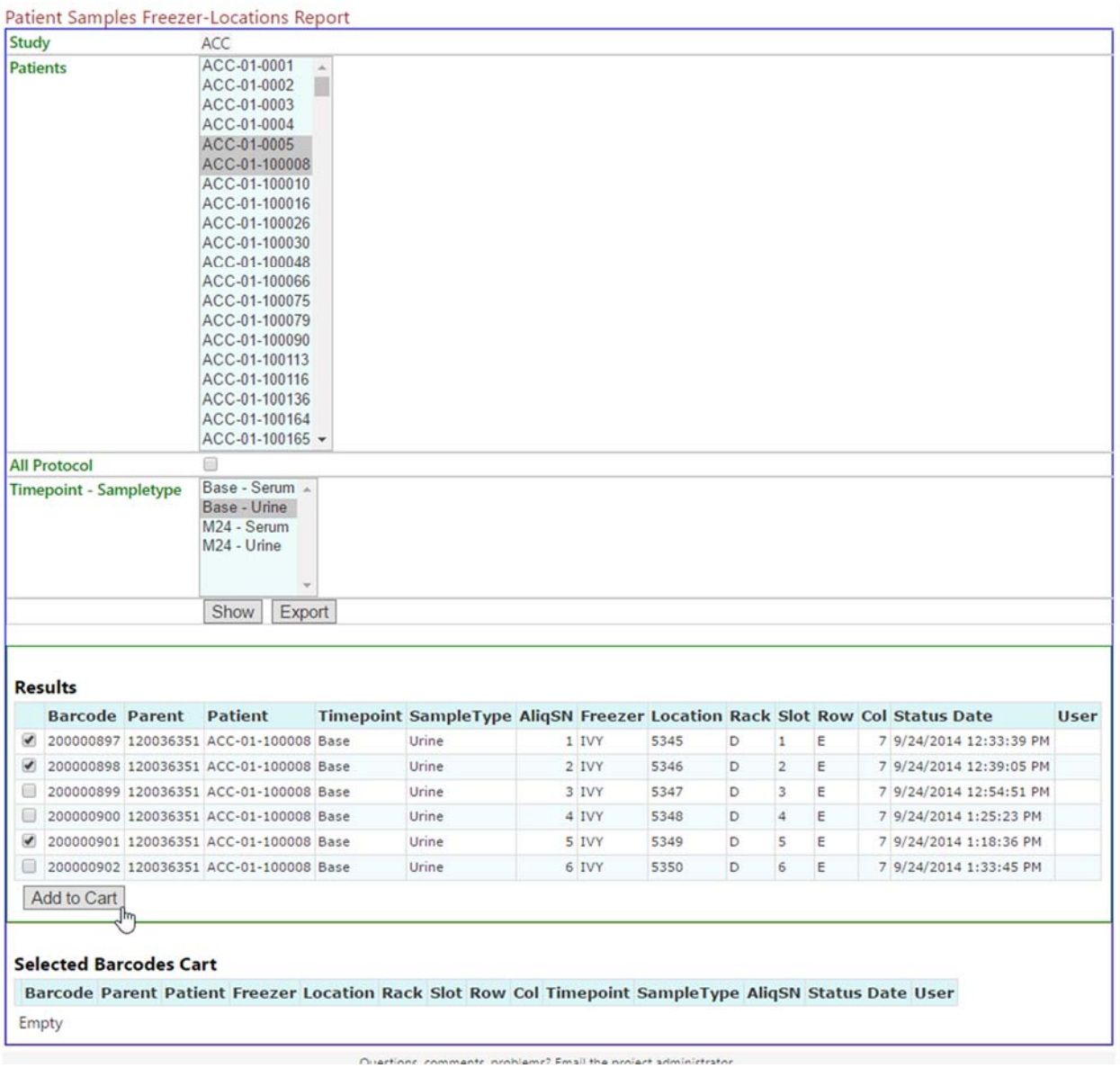
The next form allows you to select one or more patients.



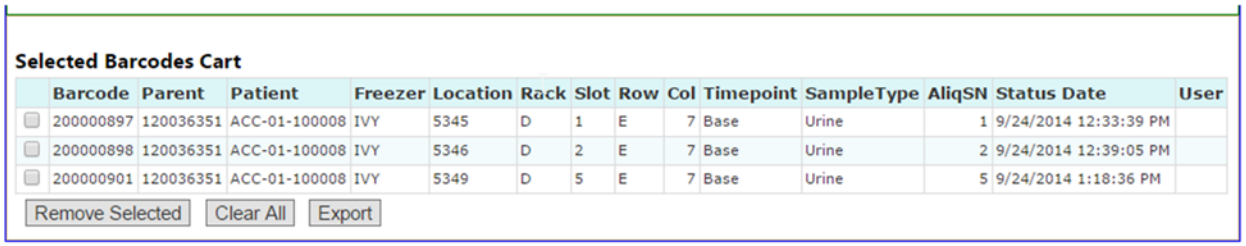
By default, all protocols (timepoints and sampletypes) are displayed to be selected individually.
Selecting “All protocol” collapses the protocol definition to include all options.

You may view the list by pressing “Show” or export to Excel.

After selecting some entries and pressing “Show”, we get two lists: a “Results” list, and a “Selected Barcodes Cart” list.



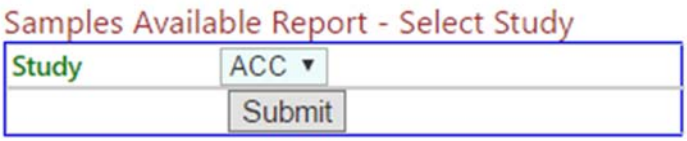
From the Results list we can select one or more barcodes and press “Add to Cart.”



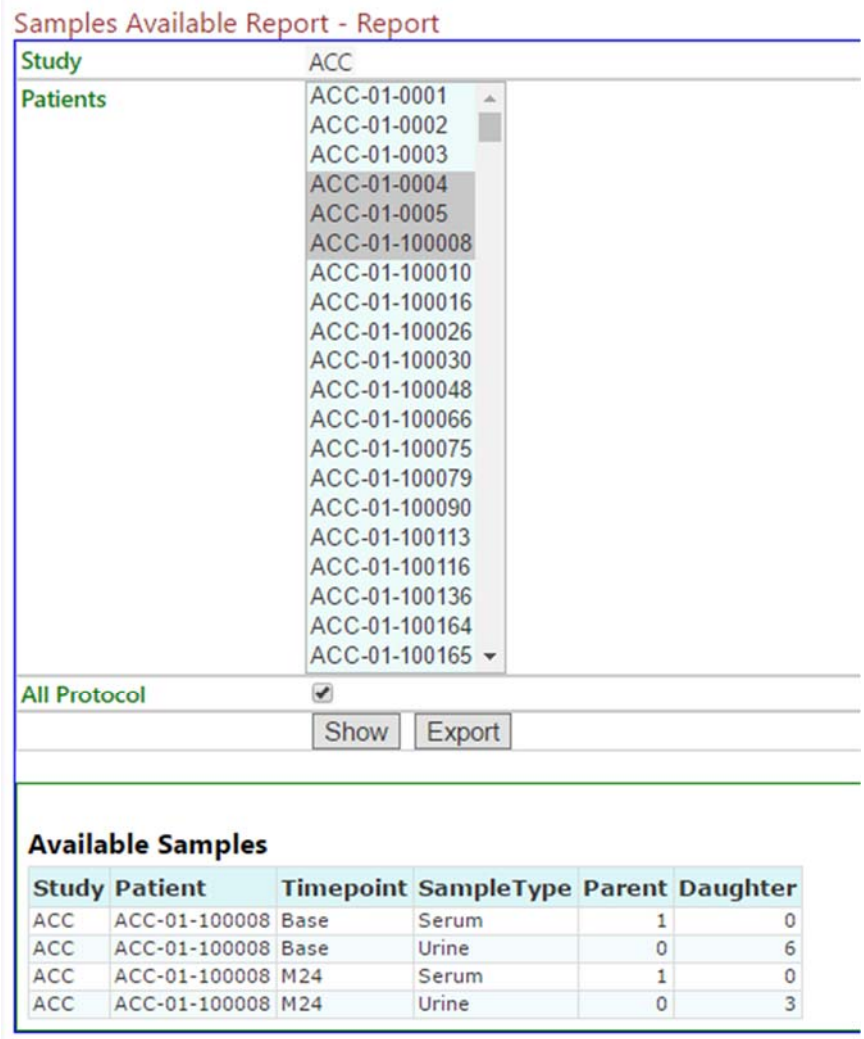
After items have been added to the Cart, new controls will be available to remove specific barcodes, clear the cart, or export the list. Items saved in the Cart are kept until they are deleted—even if a user logs out of the session.

5.7 Samples Available

Provides a summary of samples available in a study, by patient and Timepoint / Sample type.

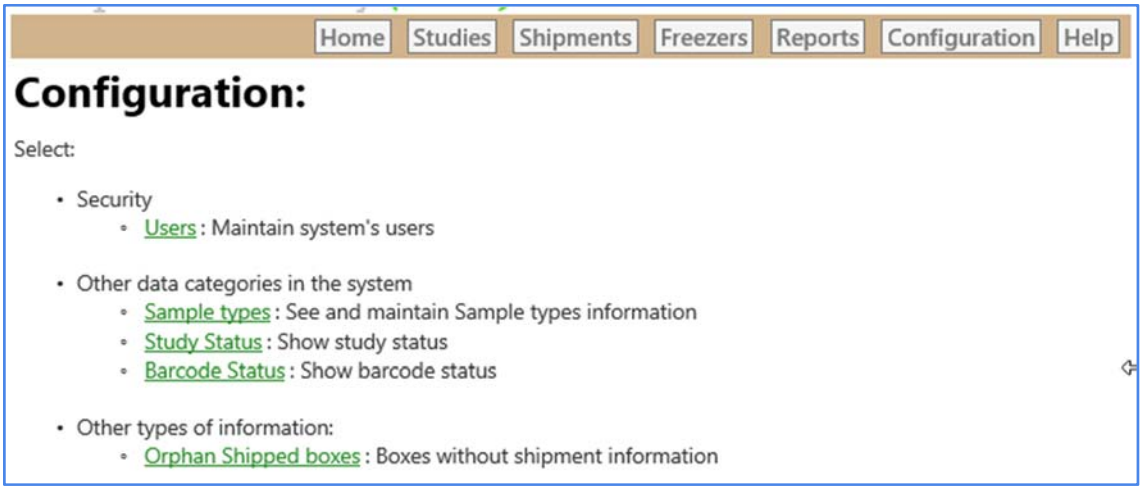


On the first screen, select a study. On the next, select study-patients and protocols. A list of available samples is produced per patient and protocol with the number of available parent and daughter samples displayed as well.



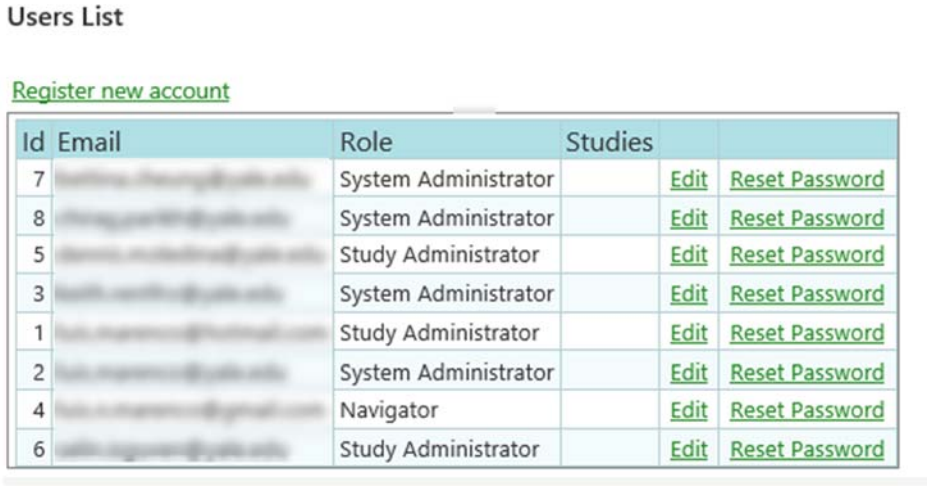
6 Configuration

This section allows you to maintain system users and other data categories.



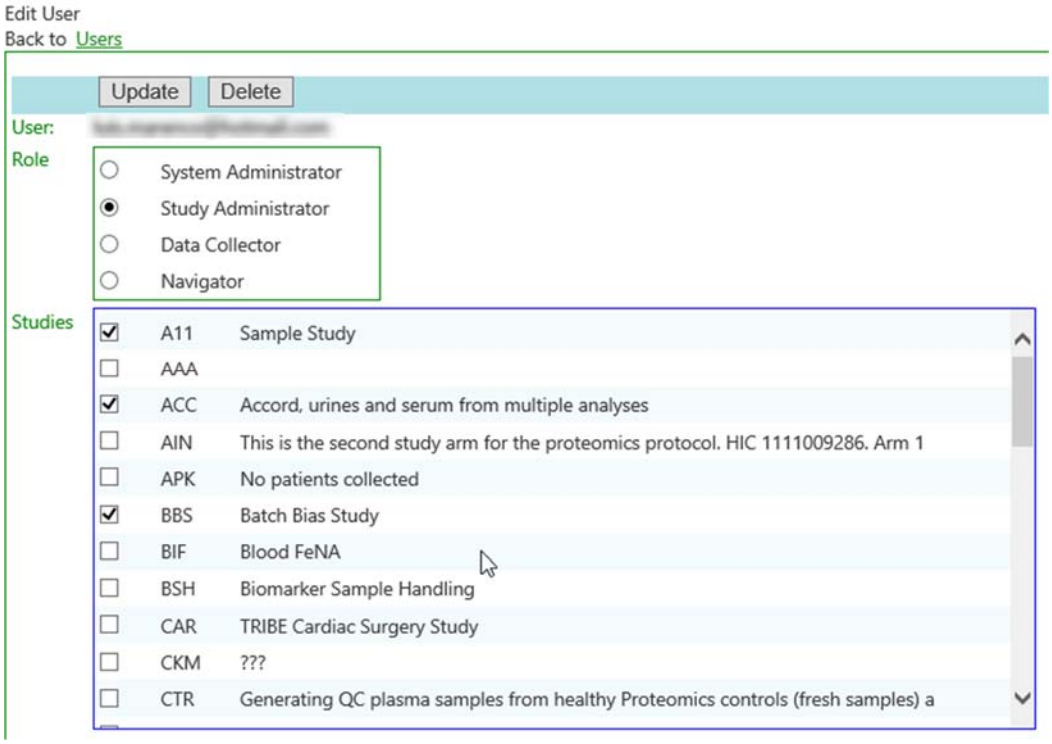
6.1 Users

If logged in as a System Administrator, you are allowed to maintain user rights.

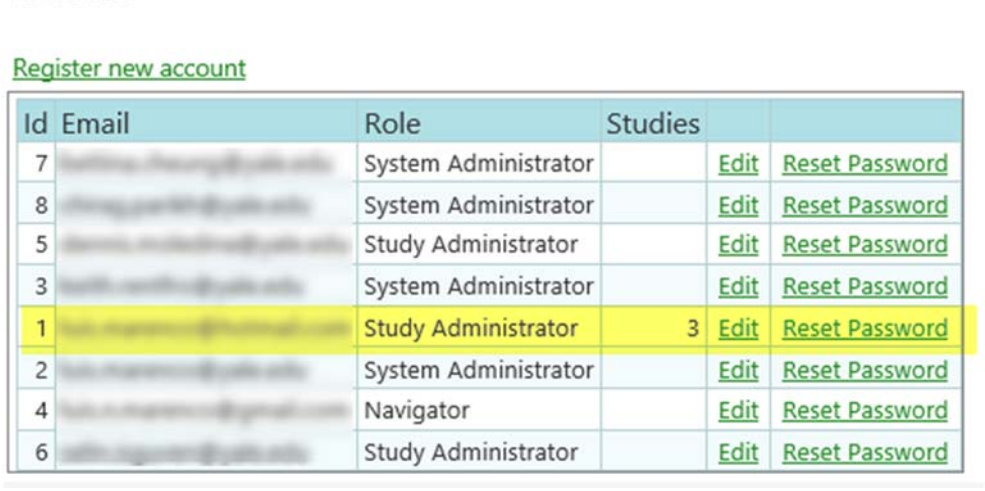


6.1.1 Changing User Roles

Click on “Edit” for a given user to modify their rights. A single role can be given to each user. That role (previously explained in the overview section) can be applied to specific studies.



After the changes are made, they are presented in the user list. Unselecting studies or changing the user role to navigator will limit the user from performing changes to the system.



6.2 Sample Types

SIDS manages a centralized list of sample types (or specimens). That list is accessible from the Configuration page section.

Sampletype List New

Id	Name	Description	Units	Color
1	Blood		uL	
2	DNA		uL	
3	EDTA Plasma		uL	
4	EmptyTube		uL	
5	ExtraPlasma		uL	
6	ExtraSerum		uL	
7	ExtraUrine		uL	
8	LIHep Plasma		uL	
9	Lymph Node	Lymph node tissue from biopsy	mg	
10	Oxalate Plasma		uL	
11	PBMC		uL	
12	PE Cytokine		uL	
13	PerfusateB		uL	
14	PerfusateL		uL	
15	PerfusateR		uL	
16	Plasma		uL	
17	Renal Biopsy	Renal Tissue-Core	mg	
18	RNASE Biopsy	Renal Tissue Treated with Rnase	mg	
19	Serum		uL	
20	Urine		uL	
21	Urine Pellet	For use in microscopy	uL	
22	Specimen slide			

Clicking on “New” will add a new sampletype. Selecting an ID will show the sampletype details. Clicking “Edit” will allow the administrator to change information about the sampletype, including which color they can be highlighted by in freezer reports.

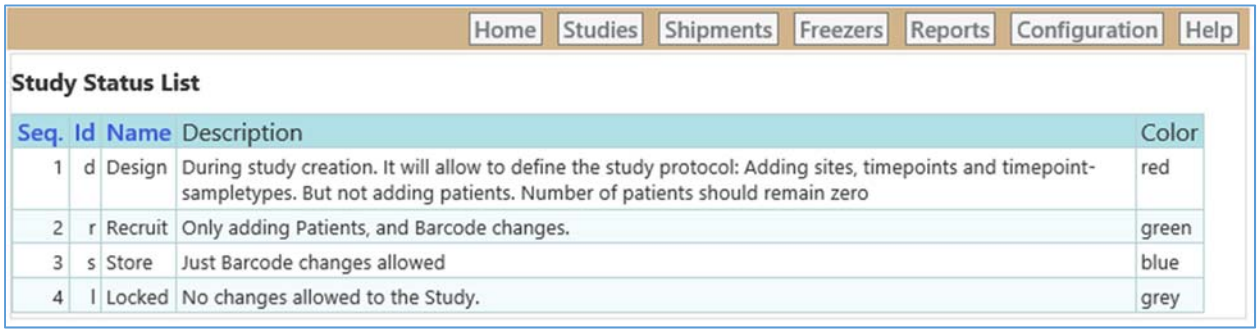
Add Edit Delete

Id	8
Name	Lymph Node
Description	Lymph node tissue from biopsy
Units	mg
Color	

Sample types information can be changed but this is not recommended when in used in a study protocols. Additionally, sample types cannot be deleted if they are being used in protocols.

6.3 Study Status

This information is read-only as reference for the user.



Study Status List

Seq.	Id	Name	Description	Color
1	d	Design	During study creation. It will allow to define the study protocol: Adding sites, timepoints and timepoint-sampletypes. But not adding patients. Number of patients should remain zero	red
2	r	Recruit	Only adding Patients, and Barcode changes.	green
3	s	Store	Just Barcode changes allowed	blue
4	l	Locked	No changes allowed to the Study.	grey

6.4 Barcode Status

This information is also offered as reference for the user.

Barcode Status List

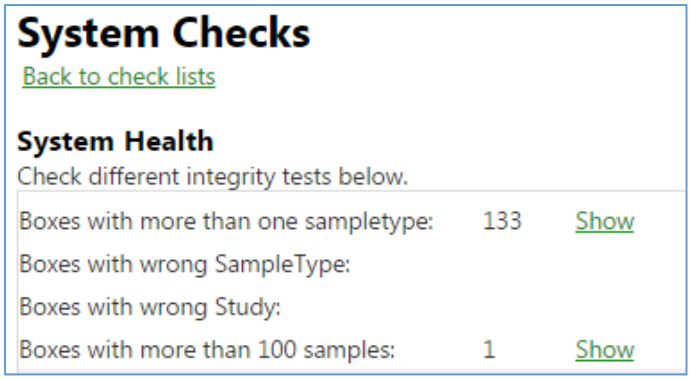
Id	Previous	Sequence	Name	Description
?		1	Unknown	Undetermined satus
c		2	Created	Generated by the system. Pending collection
f	c	3	Filled	Sample was collected and should be located in a freezer box
e	f	4	Consumed	Used by the lab
u	c	5	Unused	Sample was not collected
s	f	6	Shipped	Aliquot was shipped out
d	f	8	Disposed	Aliquot has been disposed/destroyed

6.5 Orphan Shipment Boxes

This report will list boxes without shipment information.

6.6 System Checks

These reports provide information on boxes which do not fit the rules which apply to any new samples added in SIMS. Some older boxes which were imported into SIMS do not follow the same rules as in SIMS.



7 System Architecture

7.1 System Design

SIMS is built as an internet application, using a Website and a backend relational database. The Website was created using the Microsoft .NET framework. It is written in C# language interpreted inside a razor engine. Database connectivity is done via the Entity Framework. Front end uses HTML5, DHTML via Javascript, JQuery and JSON. The Web application is hosted on Internet Information Services (IIS). As backend database SIMS uses a SQL server 2016 database system. The whole system can be hosted in a single Windows 2016 or 2102 R2, or in separated systems for database and web hosting. SIMS leverages the EvSol library for Evolvable Solutions for user interaction through web forms.

7.2 Computing Requirements

We recommend a Windows 2016 system virtual or physical with 2 CPU cores, and depending on the size of the database and expected growth; at least 20GB of free space for data.

7.3 Installation and Setup

We provide instructions to setup a single system deployment. Please make the necessary adjustments for a split system deployment.
Following are the instructions we recommend in our systems. You can modify the location of the files to match your institution/department guidelines if you understand the implications of the changes.

7.3.1.1 Installation

- Install IIS
- Install SQL server
- Create root system folder C:\Applications\SIMS
- Create Web folder C:\Applications\SIMS**Web**
- Create Database folder C:\Applications\SIMS**Data**

7.3.1.2 System Setup

- Website:
- …