Introduction

Bioanalytic laboratory data are an important part of efficacy and safety data of gene therapeutic studies. This paper presents a prototype developed in response to the needs of a good laboratory data integrator. With advent of web technology coupled with new tools in SAS, the prototype delivers a web-based solution to upload data from off-site laboratory site and further carry out QA processing. Authors will demonstrate the benefit of such an application offered in streamlining the often difficult to manage and time consuming process.

Not captured on CRF, bioanalytic data are usually supplied by the off-site laboratories where tests were done. To integrate these source data into existed clinical data management system (CDMS), it requires good collaboration from both sides. It is a task should be shared between laboratory sites and the clinical data management site at a drug company.

Because of the non-standard nature of such tests and QA requirements, there is no existing off-the-shelf CDMS handle well the process. To tackle the problem, this prototype will use the new approach. The diagram below illustrates the work procedure.

Current Process

The typical current process starts with receiving data in Excel spreadsheet files, vie mail or email from laboratory sites to the clinical data management site. Then a SAS programmer carries out data converting, checking and transferring. When a questionable data are found, the data have to be sent back to the laboratory sites.

Since the data are not captured in CRF, a data manager can not do anything about suspected data problems. On the other hand, as laboratory sites only have limited patient information from the labels, they send their data blindly to the data manager. Therefore, the data have to be sent back and forth several times until all errors or discrepancies being ironed out. This time-consuming QA procedure often takes several weeks before data can be integrated into CDMS.

The efficient communication among people involved, including the clinical, CDM and laboratory sites, makes it a critical path for speedy, completed delivery the analysis results. Beside, easily achievable bioanalytic data is another issue for gene therapeutic studies.

The challenge for a good application to manage the process demand the application should possess following characteristics:

- Provide the feature that allows laboratory sites and data management site send and receive data and/or data quality information.
- Facilitate communication between parties, and encourage collaboration among people involved.
- Simplify the tasks for study team leader to manage and access processing information.

Technically speaking, this system should be able to dynamically receive and send the data; allow multiple users online; and has a friendly graphic user interface. A web-based application
possesses all the above features; therefore, it is the best solution when facing such challenges. This prototype is our way to prove such concepts.

**Application Environment**

The new tools in SAS software has provided an environment for development compelling SAS-centric distributed web applications. The advance not only gives us a way to put this information online for instantaneous access, but also offers an intuitive graphical user interface to build dynamic applications.

The application is implemented in a TCP/IP based network environment. It consists of following components: web server, web browser, CGI script, a CGI initiated SAS batch session, and SAS application programs. The diagram below illustrated the application environment.

![Application Environment Diagram](image)

**Web server** and **browser** are the basic building blocks in all web-based application. The server carries the load of distribute information to the users' browser. And browser in turn serves not only an information display device but user interfaces as well.

**CGI script** is installed on the web server. It provides a general-purpose gateway that allows a web browser to trigger execution of specific SAS code that resides on the web server and receive the results back as an HTML page.

**SAS Applications** are programs that are written to perform a predefined processing. In this application, most programs are written in macro to be adaptive base on the user input from the web browser. Instead of plan text based output, result is an HTML format, which is returned to the web browser.

**Data Upload**

With variation of many laboratory tests, often the case of the bioanalytic data we want to upload is in different specifications. The communication about the data specification plays a critical role in the quality of final data.

Before upload, the prototype let a SAS programmer define the format including column labels within the web interface. Based on this input, SAS create a sample spreadsheet file on the web server. This arrangement will reduce the possible miscommunication about data attributes; allow a SAS programmer to pre-write the QA process.

With requested sample spreadsheet just a mouse-click away, laboratory sites can upload the data file in a correct format. See Figure 3.

![Screen For Data Upload](image)

The upload process is accomplished with a CGI script. It loads the data from a remote web browser, stored into a server's directory. Then with a button click the laboratory sites can get the confirmation on the data upload process. A batch SAS session, using the loader's input passed by CGI script, converts spreadsheet data into SAS format and further produces QA report.
**QA Process**

The bulk of the activities are within QA process. Next to the data upload, the pre-written QA program for each laboratory starts to get demographic information from CDMS and convert Excel spreadsheet file to SAS data sets. Then merge two sides of the data together to detect all possible data errors, such as missing patient id; mismatching protocol number and investigator’s site number; two patient initials with the same patient id; invalid values of age or gender or test values, etc.. Each laboratory site can decide proper remedy. When the laboratory data are used, the data have been already cleaned.

In summary this approach, which dynamically using the clinical database information to check laboratory data, enables a laboratory site to capture the latest enrollment patient information at the time of data uploading.

In this prototype, we also use some new SAS/GRAPH features to generate click-able 3D charts which allow user to further review different section of QA report. Such drill down function can better facilitating users in search for needed information.

![Fig4. Click-able Pie Chart for QA Summary](image)

When the post-processed data ready to be load into CDMS, a SAS programmer can just click a button. The SAS code behind is SQL statement to create the corresponding bioanalytic data in database tables.

**Process Management**

One important feature of this process is that it is carried out at many different locations at the same time. It is also crucial to have a good coordination for speedy deliver cleaned data for analysis.

This prototype allows users to manage the flow of information among individuals and study teams. Therefore, a user can check the status of a particular task or document to keep the track of items within the user’s scope of responsibility. A data set is created to track the progress. The status of each task is updated when the task is executing. With web browser team leader can check the status and carry out the next step in line at anytime and from anywhere. Especially, when there are many ongoing studies are running concurrently, it can assist a team better management the process in time fashion. Besides, it also gives a project manager a clear view of the resource allocation to drive the process forward smoothly.

![Fig5 The Screen for Process Documentation](image)

The capability of progress tracking streamlines the process promotes process documentation which is always important in this highly regulated industry.

**Conclusion**

Developing web-based application for loading offsite laboratory data and QA can streamline
the process and significantly raise the quality of laboratory data while reduce time and labor cost. It allows a laboratory getting the clinical demographic data to check their data before start the work circle. In the meantime, clinical can fetch the lab results at any time and from anywhere. Also such an application provides project team a feasible way to manage the process. Thus the redundant work is eliminated.

The discussion in this paper is for using a perl based CGI. But the application can run with SAS/IntrNet with only miner adjustment. The only change need is replace current CGI scrip with Broker – a component of SAS’s Dispatcher. With SAS/IntrNet, you can strengthen the application security and improve the application performance.

Acknowledgements

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