ABSTRACT
During clinical trial, it is very important for the project management to have the most recent updated clinical trial information. The best solution is dynamic access to clinical trial data: dynamic data management and dynamic data analysis. SAS® System almost became a standard programming language in clinical data analysis. With the development in Internet, people have been exploring every technical possibility to use SAS System to manage and analyze clinical trial data dynamically through Internet. SAS/IntrNet software has provided an option to use SAS System through Internet. However, there is an additional cost. This paper will present another way to use SAS System through Internet without SAS/IntrNet. An experimental example - Clinical Trial Online will be presented. Through Clinical Trial Online, the following technique will be demonstrated:

1. Remote data entry, data browsing and data editing through Internet.
2. Running SAS programs remotely and bringing the results back to users' Internet browser.
3. Building menu driven system to give users the option to analyze the data interactively through Internet.

INTRODUCTION
Clinical Trial Online is a Web interactive, point-click menu driven system. Anyone can use it. Programming is not needed from the end users. SAS system is used as database system. In reality, other DBMS can be easily adapted as database systems. From user's point of view, only a Web browser is needed. From system administrator's point of view, only a regular Web Server with CGI broker and a regular SAS system need to be set up. Most important, SAS/IntrNet is not necessary. Every time when a user clicks on a Web page and sends a request to Web Server, Web Server takes the request and communicates it through CGI to SAS System; SAS System process the request and sends the results back to Web Server, then Web Server sends the results back to the user.

The System has the following main sections:
1. Project Status
2. Study Design
3. Database Management
4. Statistical Analysis
5. Research Report
6. Reference resources

SYSTEM HIGHLIGHTS
1. PROJECT STATUS
Tracking the current database status including data verification/validation, … … .

2. STUDY DESIGN
Access study design documents (e.g. protocol, … ).

3. DATA MANAGEMENT
Through Data Management System, you can access CRF form, enter, edit and review data through Internet.

I. Data Entry
II. Data Edit
III. Data Review

4. STATISTICAL ANALYSIS
Statistical analysis has Pre-defined Analysis and Interactive Analysis/Online Analysis two sections:

A. Pre-defined Analysis
Pre-defined Analysis gives a user the option to run an existing SAS program remotely through Internet and bring the result back to the user/Web browser.

B. Interactive Analysis/Online Analysis
Interactive Analysis is a menu driven system; users can define their own analyses by just point-clicking the menus through Internet. It is featured with Descriptive Analysis, Safety Analysis (Prior/Concurrent Medication, Vital Sign, Adverse Events and Laboratory Test), ANOVA Analysis, Pairwise Comparison, Survival Analysis and Graphic Analysis. It can also generate output files in PDF format.

I. Descriptive Analysis
Descriptive Analysis System is designed for basic statistical analysis, it can be used for summary analysis. For example:
1. Demographic Information Summary
2. Study Termination Reason Summary,
3. … … etc.
II. Incidence Summary

Incidence Summary System includes: Prior/Concurrent Medication Use Analysis, Prior/Concurrent Surgical Procedure Analysis, Medical History Analysis and other Incidence analysis. It can not only summarize the incidence but also compare the equality of proportions across different groups using CMH test.

III. Adverse Events Analysis

It can not only summarize the incidence of Adverse Events but also compare the equality of proportions across different groups using CMH test.

1. Summary of Adverse Event Report
2. Incidence of Adverse Events
3. Incidence of Adverse Events by Body System
4. Incidence of Adverse Events by Severity
5. Incidence of Adverse Events by Attribution
6. Incidence of Serious Adverse Events
7. Incidence of Adverse Events Causing Withdrawal
8. Incidence of Adverse Events by Subgroup
9. Frequency of Adverse Events

IV. Vital Sign Analysis

Vital sign information can be summarized through Descriptive Analysis System.

V. Laboratory Test Analysis

1. Summary of Laboratory Test
2. Summary of Laboratory Test Change
3. Lab Test Change Relative to Normal Range
4. Laboratory Test Distribution Among Ranges
5. Laboratory Test Shift Plot

VI. ANOVA Analysis

ANOVA p-values can be calculated using GLM model.

VII. Pairwise Comparison Analysis

Pairwise comparison p-values can be calculated using GLM Model.

VIII. Survival Analysis

Proportion of survival can be estimated and the results will be presented in graphic format.

IX. Graphic Analysis

Data can be summarized and visually displayed using plot, joint line, smooth line, regression line, pie, bar or block. Data used to generate the graphs can also be displayed on the graphs for review.

5. RESEARCH REPORT

Access study research reports.

6. REFERENCE RESOURCES

Access study reference information.

A SAMPLE OF INTERACTIVE / ONLINE ANALYSIS OUTPUTS

Descriptive analysis can be used to calculate the following statistics:

N, Percent, Mean, Standard Deviation, Standard Error, Variance, C.V., Median, Q1, Q3, Granger(Q3 – Q1), P5, P95, Minimum, Maximum, Range, … … .
### Summary of Prior/Concurrent Medication Use (2)

(Summary of Prior/Concurrent Surgical Procedure)

<table>
<thead>
<tr>
<th>N=XXX</th>
<th>N=XXX</th>
<th>N=XXX</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
</tbody>
</table>

*** TOTAL ***

### Incidence of Adverse Events (2)

(Incidence of Serious Adverse Events)

(Incidence of Adverse Events Causing Withdrawal)

<table>
<thead>
<tr>
<th>ADVERSE EVENTS</th>
<th>N=XXX</th>
<th>N=XXX</th>
<th>N=XXX</th>
<th>N=XXX</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
</tbody>
</table>

*** TOTAL ***

### Summary of Adverse Events Report

<table>
<thead>
<tr>
<th>Subject Reporting AE</th>
<th>N=XXX</th>
<th>N=XXX</th>
<th>N=XXX</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
</tbody>
</table>

Subject Reporting AE By Attribution - Possible

Subject Reporting AE By Attribution - Probable

Subject Reporting AE By Attribution - Definite

Subject Reporting AE By Severity - Mild

Subject Reporting AE By Severity - Moderate

Subject Reporting AE By Severity - Severe

Subject Reporting Serious AE - Non-fatal

Subject Withdrew Due to AE

Number of Deaths

### Incidence of Adverse Events by Body System (1)

(Incidence of Serious AE by Body System)

(Incidence of AE Causing Withdrawal by Body System)

<table>
<thead>
<tr>
<th>BODY SYSTEM / ADVERSE EVENTS</th>
<th>N=XXX</th>
<th>N=XXX</th>
<th>N=XXX</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
</tbody>
</table>

*** TOTAL ***

### Incidence of Adverse Events by Body System (2)

(Incidence of Serious AE by Body System)

(Incidence of AE Causing Withdrawal by Body System)

<table>
<thead>
<tr>
<th>BODY SYSTEM / ADVERSE EVENTS</th>
<th>N=XXX</th>
<th>N=XXX</th>
<th>N=XXX</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
</tbody>
</table>

*** TOTAL ***
### Incidence of Adverse Events by Severity

<table>
<thead>
<tr>
<th>Body System / Adverse Events</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>N - XX</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>XXXXX</td>
<td>XX</td>
<td>XX.X</td>
<td>XX.X</td>
</tr>
<tr>
<td>XXXXX</td>
<td>XX</td>
<td>XX.X</td>
<td>XX.X</td>
</tr>
<tr>
<td>XXXXX</td>
<td>XX</td>
<td>XX.X</td>
<td>XX.X</td>
</tr>
<tr>
<td>XXXXX</td>
<td>XX</td>
<td>XX.X</td>
<td>XX.X</td>
</tr>
</tbody>
</table>

### Lab Test Distribution Among Ranges

**LAB TEST = XXXX**

<table>
<thead>
<tr>
<th>Lab Test</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-time</td>
<td>N</td>
<td>L</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>XXXXX1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>XXXXX2</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

### Incidence of Adverse Events by Attribution

<table>
<thead>
<tr>
<th>Body System / Adverse Events</th>
<th>Possible</th>
<th>Probable</th>
<th>Definite</th>
</tr>
</thead>
<tbody>
<tr>
<td>N - XX</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>XXXXX</td>
<td>XX</td>
<td>XX.X</td>
<td>XX.X</td>
</tr>
<tr>
<td>XXXXX</td>
<td>XX</td>
<td>XX.X</td>
<td>XX.X</td>
</tr>
<tr>
<td>XXXXX</td>
<td>XX</td>
<td>XX.X</td>
<td>XX.X</td>
</tr>
</tbody>
</table>

### Lab Test Change Relative to Normal Range

<table>
<thead>
<tr>
<th>Lab Test</th>
<th>N - XX</th>
<th>N - %</th>
<th>N - XX</th>
<th>N - %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXXXX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXXXX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XXXXX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ANOVA Analysis

Survival Analysis – Plot of Survival

Survival Analysis – Plot of Failure

Pairwise Comparison Analysis

Survival Analysis – Plot of Failure
A SAMPLE OF SYSTEM INTERNET PAGE

Main page which has links to different features

An example of data browse / review page.

Data management page that can link to CRF form, remote data entry, data editing and browsing.

Statistical analysis main page that can link to Pre-defined Analysis and Interactive/Online Analysis.

An example CRF form through which data can be entered into remote central database.

An example of Pre-defined Analysis page: each link can run an existing SAS program remotely.
An example of Pre-defined analysis output.

Interactive/Online Analysis main page can link to a lot of different analyses through Internet. Through this online menu driven system, users can define their own analyses.

An example of Adverse Events Analysis menu through Interactive Analysis System.

CONCLUSIONS

This paper highlighted the Clinical Trial Online system; There are still a lot of other features not mentioned. This system is still in the experimental stage. A lot of other data management or analysis methods can be easily incorporated. Moreover, it’s very easy to be set up.

TRADEMARKS

SAS and SAS/IntrNet are registered trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are registered trademark or trademarks of their respective companies.

REFERENCES


CONTACT INFORMATION

Your comments and questions are valued and encouraged. For detailed information, please contact the author at:

Quan Ren
765 Quince Orchard Blvd. #34
Gaithersburg, MD 20878
(240) 632-4237
E-mail: quanren@yahoo.com