

## Clinical Trial Online – Running SAS® on the Web without SAS/IntrNet®

Quan Ren

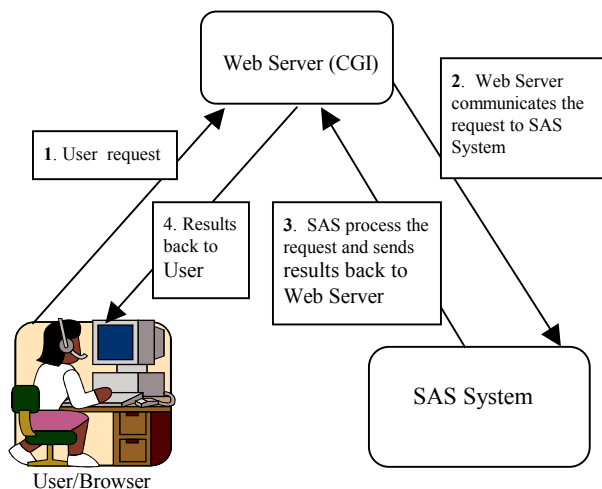
### ABSTRACT

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

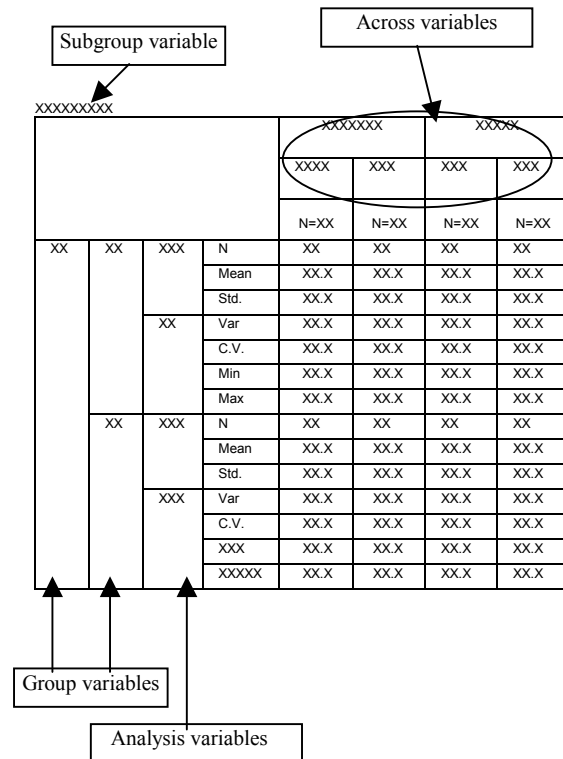
Access study reference information.

A SAMPLE OF INTERACTIVE / ONLINE ANALYSIS OUTPUTS

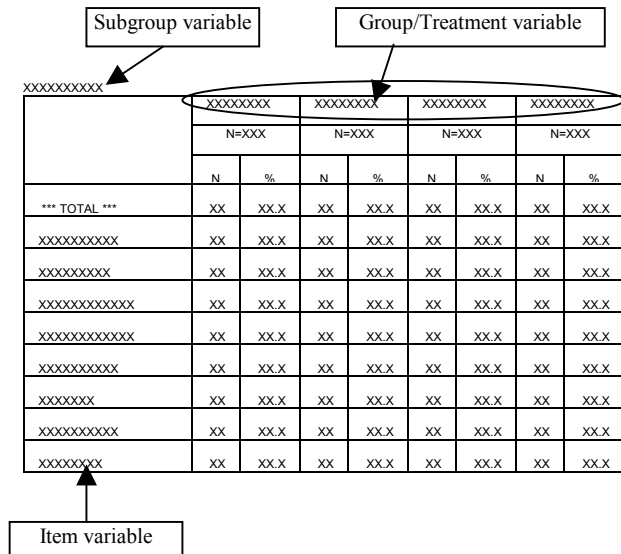
Descriptive analysis can be used to calculate the following statistics:

N, Percent, Mean, Standard Deviation, Standard Error, Variance, C.V., Median, Q1, Q3, Qrange( Q3 – Q1), P5, P95, Minimum, Maximum, Range, ... .

Descriptive Analysis



Summary of Prior/Concurrent Medication Use (1)  
(Summary of Prior/Concurrent Surgical Procedure)



**Summary of Prior/Concurrent Medication Use (2)**  
**(Summary of Prior/Concurrent Surgical Procedure)**

XXXXXXXXXX	XXXXXXXXXX		XXXXXXXXXX		XXXXXXXXXX		P-value
	N=XXX		N=XXX		N=XXX		
	N	%	N	%	N	%	
*** TOTAL ***	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX

**Incidence of Adverse Events (2)**  
**( Incidence of Serious Adverse Events )**  
**(Incidence of Adverse Events Causing Withdrawal)**

XXXXXXXXXXXX	XXXXXXXXXX		XXXXXXXXXX		XXXXXXXXXX		P-value
	N=XXX		N=XXX		N=XXX		
	N	%	N	%	N	%	
*** TOTAL ***	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	X.XXX

**Summary of Adverse Events Report**

XXXXXXXXXX	XXXXXX		XXXXXX		XXXXXX	
	N=XXX		N=XXX		N=XXX	
	N	%	N	%	N	%
Subject Reporting AE	XX	XX.X	XX	XX.X	XX	XX.X
Subject Reporting AE By Attribution - Possible	XX	XX.X	XX	XX.X	XX	XX.X
Subject Reporting AE By Attribution - Probable	XX	XX.X	XX	XX.X	XX	XX.X
Subject Reporting AE By Attribution - Definite	XX	XX.X	XX	XX.X	XX	XX.X
Subject Reporting AE By Severity - Mild	XX	XX.X	XX	XX.X	XX	XX.X
Subject Reporting AE By Severity - Moderate	XX	XX.X	XX	XX.X	XX	XX.X
Subject Reporting AE By Severity - Severe	XX	XX.X	XX	XX.X	XX	XX.X
Subject Reporting Serious AE - Non-fatal	XX	XX.X	XX	XX.X	XX	XX.X
Subject Withdrawn Due to AE	XX	XX.X	XX	XX.X	XX	XX.X
Number of Deaths	XX	XX.X	XX	XX.X	XX	XX.X

**Incidence of Adverse Events by Body System (1)**  
**( Incidence of Serious AE by Body System )**  
**(Incidence of AE Causing Withdrawal by Body System)**

XXXXXXXXXX	BODY SYSTEM / ADVERSE EVENTS	XXXXXXXXXX		XXXXXXXXXX		XXXXXXXXXX	
		N=XXX		N=XXX		N=XXX	
		N	%	N	%	N	%
XXXXXX	*** TOTAL ***	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
XXXXXX	*** TOTAL ***	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X

**Incidence of Adverse Events (1)**  
**( Incidence of Serious Adverse Events )**  
**(Incidence of Adverse Events Causing Withdrawal)**

XXXXXXXXXXXX	XXXXXXXXXX		XXXXXXXXXX		XXXXXXXXXX		XXXXXXXXXX	
	N=XXX		N=XXX		N=XXX		N=XXX	
	N	%	N	%	N	%	N	%
*** TOTAL ***	XX	XX.X	XX	XX.X	XX	XX.X	XX	XX.X
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	XX	XX.X
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	XX	XX.X
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	XX	XX.X
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	XX	XX.X
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	XX	XX.X
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	XX	XX.X
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	XX	XX.X
XXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X	XX	XX.X

**Incidence of Adverse Events by Body System (2)**  
**( Incidence of Serious AE by Body System )**  
**(Incidence of AE Causing Withdrawal by Body System)**

XXXXXXXXXXXX	BODY SYSTEM / ADVERSE EVENTS	XXXXXXXXXX		XXXXXXXXXX		P-value
		N=XXX		N=XXX		
		N	%	N	%	
XXXXXX	*** TOTAL ***	XX	XX.X	XX	XX.X	X.XXX
	XXXXXXXXXXXX	XX	XX.X	XX	XX.X	X.XXX
	XXXXXXXXXXXX	XX	XX.X	XX	XX.X	X.XXX
	XXXXXXXXXXXX	XX	XX.X	XX	XX.X	X.XXX
XXXXXX	*** TOTAL ***	XX	XX.X	XX	XX.X	X.XXX
	XXXXXXXXXXXX	XX	XX.X	XX	XX.X	X.XXX
	XXXXXXXXXXXX	XX	XX.X	XX	XX.X	X.XXX
	XXXXXXXXXXXX	XX	XX.X	XX	XX.X	X.XXX

**Incidence of Adverse Events by Severity**

BODY SYSTEM / ADVERSE EVENTS		XXXXXXXXXXXXXXXXXXXX					
		N=XXX					
		Mild		Moderate		Severe	
		N	%	N	%	N	%
XXXXXX	*** TOTAL ***	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
XXXX	*** TOTAL ***	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X

**Lab Test Distribution Among Ranges**

LAB TEST = XXXXX

XXXXXX1					XXXXXX2				
(N)	H	L	N	TOTAL	(N)	H	L	N	TOTAL
H	3	0	0	3	H	2	0	1	3
L	0	4	0	4	L	0	4	2	6
N	0	1	73	74	N	1	1	68	70
TOTAL	3	5	73	81	TOTAL	3	5	71	79
<PRE-TIME>					<PRE-TIME>				
POSTTIME					POSTTIME				

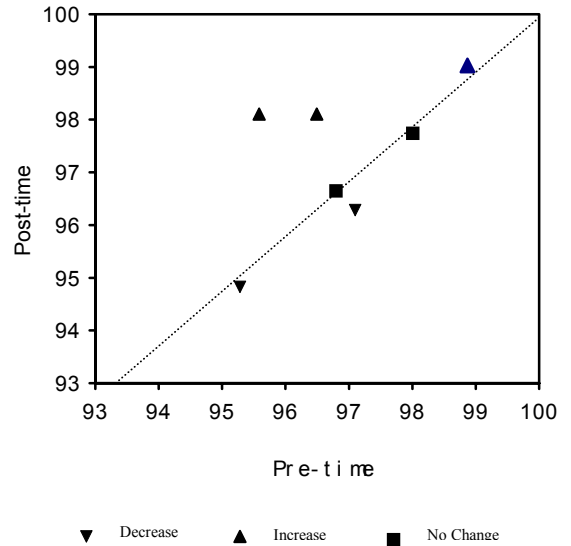
XXXXXX1					XXXXXX2				
(%)	H	L	N	TOTAL	(%)	H	L	N	TOTAL
H	3.7	0	0	3.7	H	2.5	0	1.3	3.8
L	0	4.9	0	4.9	L	0	5.1	2.5	7.6
N	0	1.2	90.1	91.4	N	1.3	1.3	86.1	88.6
TOTAL	3.7	6.2	90.1	100.0	TOTAL	3.8	6.3	89.9	100.0
<PRE-TIME>					<PRE-TIME>				
POSTTIME					POSTTIME				

**Incidence of Adverse Events by Attribution**

BODY SYSTEM / ADVERSE EVENTS		XXXXXXXXXXXXXXXXXXXX					
		N=XXX					
		Possible		Probable		Definite	
		N	%	N	%	N	%
XXXXXX	*** TOTAL ***	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
XXXX	*** TOTAL ***	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X
	XXXXXXXXXXXXXX	XX	XX.X	XX	XX.X	XX	XX.X

**Lab Shift Plot**

LAB TEST= XXXX, TREATMENT=XXXX (N=XXX)



**Lab Test Change Relative to Normal Range**

LAB TEST		XXXXXXXXXX		XXXXXXXXXX		XXXXXXXXXX	
		N	%	N	%	N	%
XXXXXXXXXX	Decrease	XX	XX.X	XX	XX.X	XX	XX.X
	Increase	XX	XX.X	XX	XX.X	XX	XX.X
	No change	XX	XX.X	XX	XX.X	XX	XX.X
	Total	XX	XX.X	XX	XX.X	XX	XX.X
XXXXXX	Decrease	XX	XX.X	XX	XX.X	XX	XX.X
	Increase	XX	XX.X	XX	XX.X	XX	XX.X
	No change	XX	XX.X	XX	XX.X	XX	XX.X
	Total	XX	XX.X	XX	XX.X	XX	XX.X
XXXXXX	Decrease	XX	XX.X	XX	XX.X	XX	XX.X
	Increase	XX	XX.X	XX	XX.X	XX	XX.X
	No change	XX	XX.X	XX	XX.X	XX	XX.X
	Total	XX	XX.X	XX	XX.X	XX	XX.X

**ANOVA Analysis**

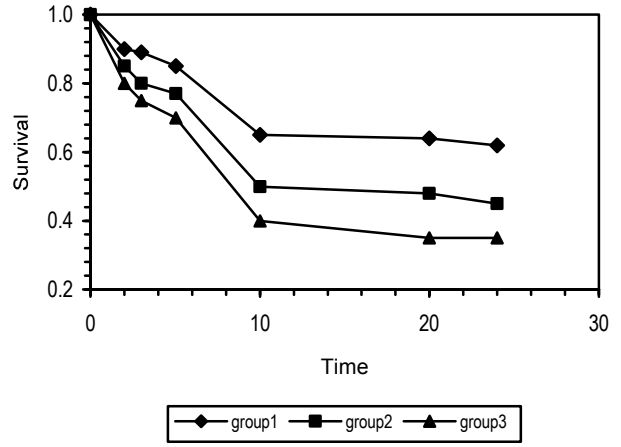
	xxxxxxx	xxxxxxx	xxxxxxx	xxxxxxx
xxxxxxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx
xxxxxxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx
xxxxxxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx
xxxxxxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx
xxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx
xxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx
xxxxxxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx

Group variable

Analysis variables

P-values

**Survival Analysis – Plot of Survival**



**Pairwise Comparison Analysis**

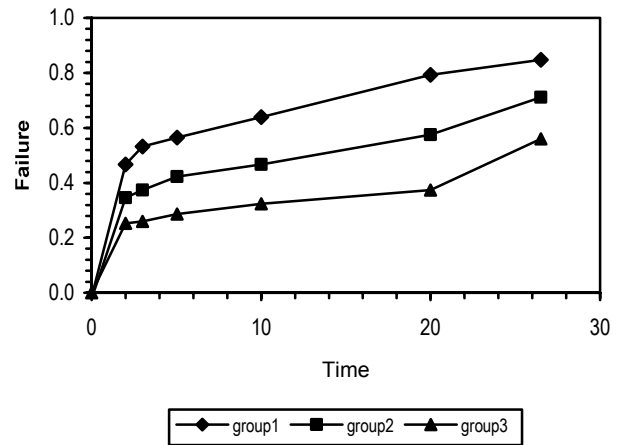
	xxxxxxx vs xxxxxxx	xxxxxxx vs xxxxxxx	xxxxxxx vs xxxxxxx	xxxxxxx vs xxxxxxx
xxxxxxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx
xxxxxxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx
xxxxxxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx
xxxxxxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx
xxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx
xxxxxxxxxxxx	x.xxx	x.xxx	x.xxx	x.xxx

Pairwise Comparisons

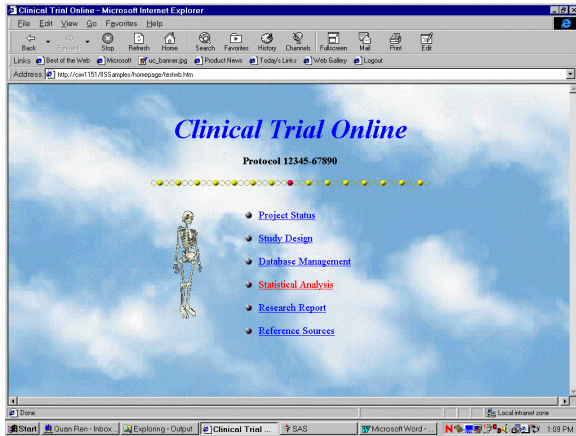
Analysis variables

P-values

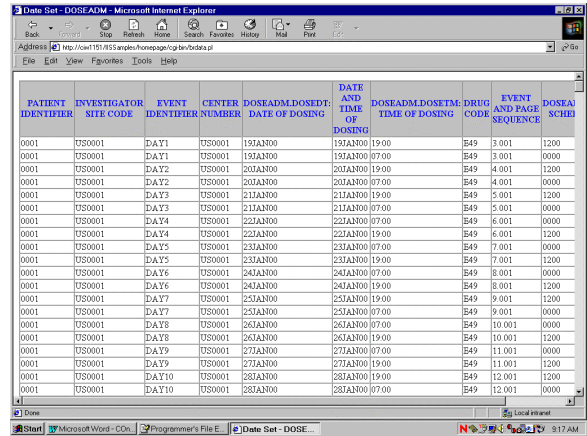
**Survival Analysis – Plot of Failure**



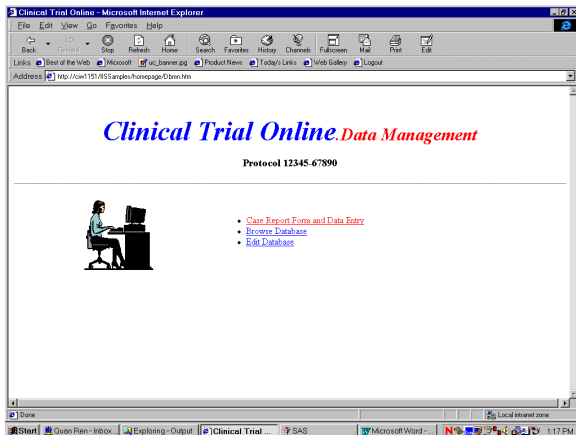
A SAMPLE OF SYSTEM INTERNET PAGE



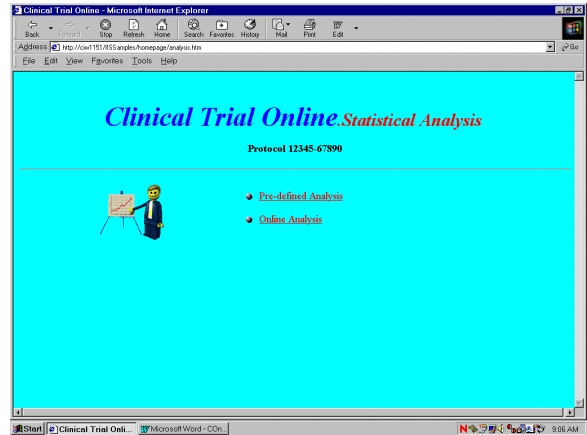
Main page which has links to different features



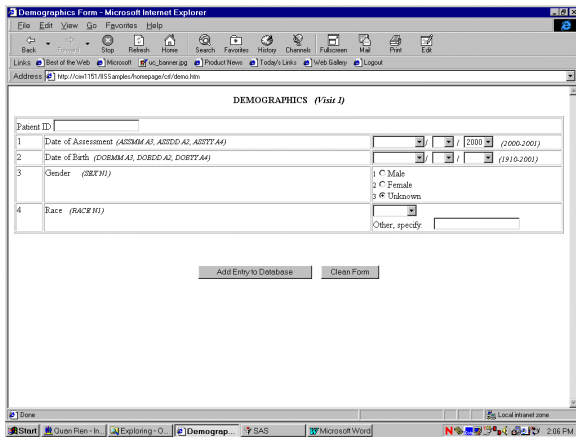
An example of data browse / review page.



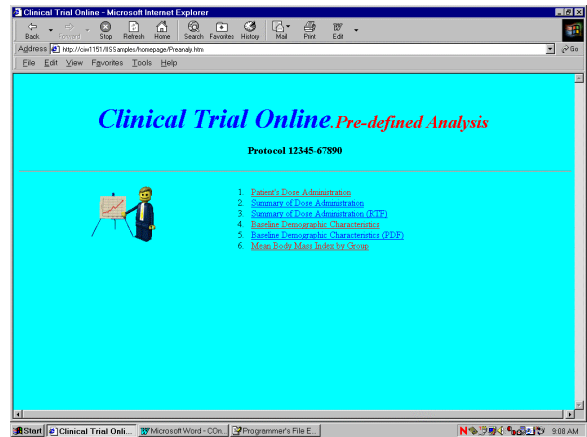
Data management page that can link to CRF form, remote data entry, data editing and browsing.



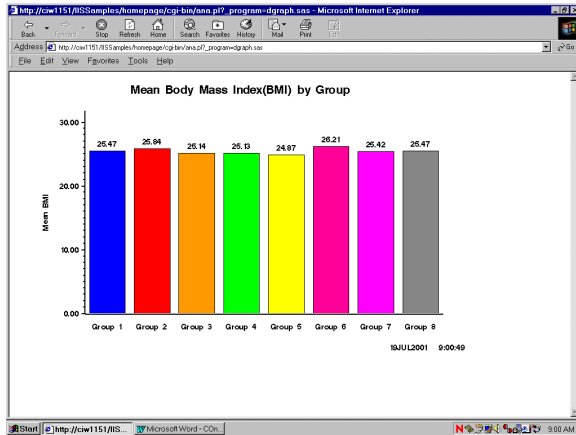
Statistical analysis main page that can link to Pre-defined Analysis and Interactive/Online Analysis.



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.

	Treatment 1		Treatment 2		Treatment 3		Total	
	N	%	N	%	N	%	N	%
**** TOTAL ****	2	22.2	1	11.1	3	33.3		
GENERAL DISORDERS								
ASTHMA	1	11.1	0	0	0	0		
BACK PAIN	1	11.1	1	11.1	1	11.1		
CHEST PAIN	0	0	0	0	1	11.1		
FEVER	0	0	0	0	1	11.1		
HOT FLUSHES	0	0	0	0	1	11.1		
INJURY-ACCIDENTAL	1	11.1	0	0	1	11.1		
CENTRAL AND PERIPHERAL NERVOUS SYSTEM DISORDERS								
**** TOTAL ****	3	33.3	1	11.1	3	33.3		
DIZZINESS	3	33.3	0	0	1	11.1		
HEADACHE	2	22.2	1	11.1	2	22.2		
GASTRO-INTESTINAL SYSTEM DISORDERS								
**** TOTAL ****	3	33.3	3	33.3	4	44.4		
ABDOMINAL PAIN	1	11.1	2	22.2	2	22.2		

An example of Interactive/Online 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

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## REFERENCES

SAS Institute Inc. (1990), *SAS Language: Reference, Version 6, First Edition*, Cary, NC: SAS Institute Inc.

## 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