

Data Collection, Database Management and Reporting in Real-Time based on SAS® and Other Applications

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ABSTRACT

One of the most expensive aspects of collecting data is ascertaining the quality of the data collected.

The focus of the California Perinatal Quality Care Collaborative (CPQCC) is the development of perinatal and neonatal outcomes and information, which allows for data driven performance improvement and benchmarking throughout California.

The CPQCC base management and reporting system was designed to offer an efficient way to allow a) on-line data submission that would be convenient for CPQCC participants, b) instant error checking, and c) real-time reporting resulting in a high quality database supporting informed decisions. Also developed was a separate annual report module that allows the establishment and monitoring of QI goals. SAS®/BASE, SAS/IntrNet®, SAS/GRAPH®, MS Office/Access, MS Office/Excel, Winrar, Adobe Acrobat Distiller, and JavaScript were integrated to form this application.

This presentation summarizes and demonstrates the on-line CPQCC database management and reporting system.

INTRODUCTION

The goal of the California Perinatal Quality Care Collaborative (CPQCC) is the development of perinatal outcomes and information in a data repository that would allow data driven performance improvement and benchmarking throughout California. Part of this goal was the creation of a *CPQCC Master Database* whose content was designed by experts from a variety of relevant backgrounds to provide a basis for setting and achieving QI goals.

CPQCC was started prior to the more common usage of the WWW as a data collection tool. Two years ago when we were introduced to the project, the initiative had about 40 participating centers. Data were submitted either electronically or on paper forms. Data errors were a problem as well as data handling errors. For instance, the scanning process that was used to take in data submitted on paper forms, introduced errors on its own. The data correction process was elaborate and staff-intensive. A related problem was that errors could not be diagnosed in real-time. Rather there was a delay between receiving data and informing a hospital of the errors. The hospital had to go back and pull records and re-submit a new paper form or EDS record.

Error reports, quarterly reports and annual summary reports were voluminous and took a lot of staff time to produce. Furthermore, the programming solutions were not always based on the same programming platform.

As interest in the CPQCC initiative grew, it was anticipated that 80 or more additional centers would join resulting in a tripling of the work load of the data center.

INFRASTRUCTURE

CPQCC utilized several different applications:

- Teleform was used to scan data submitted on paper; scanned data were transferred into an MS Office/Access database.
- MS Office/Access was used to organize information on hospital contact information, the scanned paper forms, and some electronically submitted data.
- Comma separated ASCII files were used to organize some electronically submitted data.
- MS Office/Excel and MS Office/Word in conjunction with Java and/or SAS were used to compile error and quarterly reports.
- Adobe Acrobat Writer and Distiller were used to convert MS Office/Excel documents into PDF documents.
- SAS was used to generate several research reports and provide customized data analyses.

SOLUTION

A WWW-based application was built to handle data base management and reporting tasks. A first web site <http://www.cpgccdata.org> was created to perform data base management tasks, error and quarterly reporting. A second web site <http://www.cpgccreport.org> was created to handle the voluminous annual reports. The decision to use two different web addresses was based on the different audiences targeted: Data base management functions were targeted at hospital staff handling data entry while annual reporting functions were targeted at executive level staff seeking tools to develop and monitor QI initiatives.

This solution required several additional applications:

- MySQL and PHP were used to handle the password protected login mechanism of member hospitals to the data base management web site.

- JavaScript was used for interacting with the user on the web site. It was one primary tool to accomplish real-time error checking of data prior to its submission.
- SAS/IntrNet was used to handle all tasks that involved access to the *CPQCC Master DB*.

Due to problems with platform dependence, the role of Java was greatly reduced.

The remaining sections demonstrate the data base management and reporting web sites further. Included in this paper are also code samples that show ways in which SAS and other applications were combined to allow smooth, relatively CPQCC staff independent data collection and reporting.

WWW-BASED DATA BASE MANAGEMENT

Figure 1: CPQCC DB Management Start Up Screen

To further explain the components of the web-based data base management, Figure 1 shows the start up screen that is displayed to the hospital user upon successful login. Note that you can access a demonstration version of the CPQCC DB Management and Reporting web site by going to <http://www.cpqccdata.org> and supplying the username 0000 and the password test. You can demo all the functionalities of the website that are open to the hospital user, any data submitted for the demonstration hospital 0000 are ignored for executive and network reports.

ADD NEW DATA

To add records for a new baby that was admitted to a member hospital certain eligibility criteria have to be met. These criteria are checked first. If a baby is eligible, the user has to assign a unique and new ID to this baby. If this baby died in the delivery room, a shorter form needs to be filled out. Once the user submits the information, the application server is contacted to verify whether the infant ID is already present in the *CPQCC Master DB*. If it is not, an empty form is loaded; otherwise, the form is loaded and the information already submitted retrieved from the *CPQCC Master DB*.

The code below is used to determine whether the baby's ID is already present in the *CPQCC Master DB*. It is a small part of the "gatekeeper" program that determines how a request from the web server is handled by the application server. The macro variable &ToDo has to be submitted with each request from the web server. It determines what output the application server produces.

```
[ ... ]
%ELSE %IF &ToDo EQ %STR(lookupID) %THEN %DO; /* check whether ID exists for
                                             hospital number */

%IF &byear EQ prevyear %THEN %LET
    CohortYear=%EVAL(%SYSFUNC(YEAR(%SYSFUNC(today())) - 1);
%ELSE %LET CohortYear=%SYSFUNC(YEAR(%SYSFUNC(today())));
PROC SQL NOPRINT;
    SELECT COUNT(*)
           INTO :nobsCHECK
           FROM cpqcc.CPQCCmaster (READ=xxxxxxx
           WHERE=( _recent EQ 'Y' AND id EQ &id AND hospno EQ &hospno));

QUIT;
```

```

%IF &nobsCHECK > 0 %THEN %DO;
    %loadIDWWW;
%END;
%ELSE %DO;
    %addDataWWW;
%END;
%END;
[...]
```

If the macro variable &nobsCHECK is 0, the application server runs the macro %addDataWWW which generates an empty form to enter data in.

```

/*
Macro loads an empty form into the browser for the hospital number, baby ID, and
birth year that was provided by the user on the previous screen.
Note that the largest part of the form is loaded from the file
    DataEntryForm.html
stored in the directory
    c:\...\CPQCC\BETA\DB management\maclib
The path to all pictures in this file is HARD coded to the root directory of the web
server. Make sure that the pix directory is present in the root of the web server.
*/
%MACRO addDataWWW;
%GLOBAL SubmitType CohortYear id hospno commonwwwroot deldie keycode cpqccroot;
DATA _NULL_;
    FILE _webout;
%IF &deldie EQ 0 %THEN %DO;
    INFILE "&cpqccroot\DB management\maclib\DataEntryForm.html"
        LRECL=257 PAD END=lastobs;
%END;
%ELSE %DO;
    INFILE "&cpqccroot\DB management\maclib\DataEntryFormDRD.html"
        LRECL=257 PAD END=lastobs;
%END;
IF _N_ EQ 1 THEN DO;
    PUT '<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" ';
    PUT '"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">';
    PUT '<html xmlns="http://www.w3.org/1999/xhtml">';
    PUT '<head>';
    PUT '<title>CPQCC DB Management</title>';
    PUT '<meta name="Author" content="Beate Danielsen"></meta>';
    PUT '<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-5"></meta>';
    PUT '<meta name="date" content="2000-04-05T10:52:00+00:00"></meta>';
    PUT '<link rel="stylesheet" href="" "&commonwwwroot.CSS/forms.css";';
    PUT '    type="text/css"></link>';
    PUT '<style type="text/css">';
    [ ... more CSS style instructions deleted ... ]
    PUT '</style>';
    PUT '<script language="JavaScript" type="text/javascript">';
    PUT '<!--';
    PUT 'function loadId(form) {';
    PUT '    form.hospno.value = "" "&hospno" " "';
    PUT '    form.hospno.readOnly = true;';
    PUT '    form.id.value      = "" "&id" " "';
    PUT '    form.id.readOnly = true;';
    PUT '    form.byear.value   = "" "&CohortYear" " "';
    PUT '    form.byear.readOnly = true;';
    PUT '    for (var i=1; i<parseInt(form.bdateyy.length); i++)';
    PUT '    {';
    PUT '        if ((form.bdateyy.options[i].text) == form.byear.value) '
    PUT '        {form.bdateyy.selectedIndex = i; i=parseInt(form.bdateyy.length);}';
    PUT '    }';
    PUT '    form.bdateyy.disabled = true;';

```

```

PUT '   form.bdatemm.selectedIndex = 0;';
PUT '   form.bdatedd.selectedIndex = 0;';
PUT '};';
PUT '// -->';
PUT '</script>';
[ ... more put statements to include JavaScript deleted ... ]
PUT '<script language="JavaScript" type="text/javascript">';
PUT '<!--';
PUT 'function allowSubmitErrors(form)';
PUT '{';
PUT '   if (form.allowErrors.checked == true) {';
PUT '       form.allowErrorsHidden.value = "Y";';
PUT '       form.ToDo.disabled = false;';
PUT '       for(var i = 0; i < form.length; i++) {';
PUT '           form.elements[i].disabled = false;';
PUT '       }';
PUT '   }';
PUT '   else if (form.allowErrors.checked == false) formStatus(form,"N");';
PUT '};';
PUT '//-->';
PUT '</script>';
PUT '</head>';
PUT '<body onload="initializeGlobals();" @@';
PUT '       DataCheck(document.DataEntry, ' "'byear" ' '); ' @@';
PUT '       loadId(document.DataEntry); ' @@';
PUT '       showMonth(document.DataEntry, ' "'bdate" ' ');">';
PUT '<form method="post" name="DataEntry" action="' &_URL" "'>';
PUT '<table>';
PUT '<tr><th width="800" class="h1">CPQCC Data Management</th></tr>';
PUT '<tr><th class="h2">New Infant ID - Add New Data On-Line</th></tr>';
END;
PUT @1 thisline $CHAR256.;
IF lastobs THEN DO;
    PUT '<input type="hidden" name="_service" value="' &_SERVICE" "' />';
    PUT '<input type="hidden" name="keycode" value="' &_keycode" "' />';
    PUT '<input type="hidden" name="cpqccwwroot" value="' &_cpqccroot" "' />';
    PUT '<input type="hidden" name="_debug" value="' &_debug" "' />';
    PUT '</form>';
    PUT '</body>';
    PUT '</html>';
END;
RUN;
%MEND addDataWWW;

```

The %addDataWWW macro shows one of the important features we have implemented for the CPQCC Database Management web site. JavaScript is used to populate form data, and SAS is used to generate the appropriate JavaScript statements. The largest portion of the form is loaded from the appropriate HTML file based on the &deldie macro parameter (indicating whether or not the data pertain to a delivery room death) that is transmitted with the request from the website. Changes to the form can easily be implemented. The top part of the form is populated via the JavaScript function loadID and executed when the form is loaded into the browser as part of the <body onload="..."> tag. Finally, the form on the HTML page is properly initialized via the <form> tag. Variables needed for proper execution of the form are transmitted as hidden input elements. Figure 2 displays a part of the data entry form that is displayed.

Network ID
Hospital No.
Birth Year

Click on the arrow to the left of a category to display the respective part of the form.
 to toggle the display of the entire form.

The sections **Identification and Demographics** and **Delivery and Maternal History** should be filled out when an eligible infant is admitted to your NICU.

The **post-delivery diagnoses and interventions sections** (Respiratory, infections, other diagnoses, surgeries, and surgical complications, neurological, and congenital malformations) and the **initial disposition section** should be filled out when the baby is discharged for the first time from your center.

The **transfer section** only needs to be filled out if the infant was transferred after its initial stay.

- ▶ **Identification and Demographics** (Items 1-7)
- ▶ **Delivery and Maternal History** (Items 8-20)
- ▶ **Post-Delivery Diagnoses and Interventions -- Respiratory** (Items 21-33)
- ▶ **Post-Delivery Diagnoses and Interventions -- Infections** (Items 34-36)
- ▶ **Post-Delivery Diagnoses and Interventions -- Other diagnoses, surgeries, and surgical complications** (Items 37-42)
- ▶ **Post-Delivery Diagnoses and Interventions -- Neurological** (Items 43-46)
- ▶ **Post-Delivery Diagnoses and Interventions -- Congenital Malformations** (Item 47)
- ▶ **Initial Disposition** (Items 48-52)
- ▶ **Transfer Information** (Items 53-60)

Check here to mark this record as deleted [Click here for help.](#)

Check here to indicate that infant is still hospitalized on 05/01/2006 (at close-out). [Click here for help.](#)

Only click on Submit Data once. Depending upon how busy the system is, it can take more than a minute to complete a submission

Allow Errors to be written to CPQCC database (administrators only)

 This request took 5.73 seconds of real time (v9.1 build 1461).

Figure 2: Data Entry Form loaded into the user's browser

▼ **Identification and Demographics** (Items 1-7)

1. **Birth Weight** grams
2. **Best estimate of gestational age** Weeks: Days: Unknown
3. **Birth Date**
4. **Infant Sex** Female Male Unknown
5. **Died in Delivery Room** Yes No

Figure 3: Detail of Data Entry Screen

Sections of the form open up upon clicking on the arrow next to the form section as is shown in Figure 3. Note that item 5 is already filled out as the user requested a form for a baby that did not die in the delivery room.

JavaScript is used to verify that the form is filled out correctly and give immediate feedback to the user if an inconsistency is discovered. Only if the entire form is filled out correctly, it can be submitted.

EDIT DATA

Data can be edited by generating a list of IDs already present in the *CPQCC Master DB* for the member hospital currently logged on. This list is generated by the application server. It shows when the record was last updated, whether or not the record is complete, how many errors and how many unknown items were submitted for this ID.

IDs submitted as of 2005-07-13, 13:51

Center: 0000

Demonstration Center

Records are listed in ascending order by ID.
For WWW submissions, a pending record might be listed as having an error. This is usually resolved once the input for the record is completed.

Click on an ID to edit it:

ID	Last Updated	Status	Errors	Unknown Items	ID	Last Updated	Status	Errors	Unknown Items
00001	11MAY05:11:29:04	Complete	0	7	00002	17FEB05:20:54:24	Complete	0	0
00003	11APR05:14:58:08	Complete	0	1	00004	23FEB05:08:53:20	Complete	0	0
00005	09FEB05:20:20:16	Complete	0	1	00006	07FEB05:21:41:20	Complete	0	9
00007	07FEB05:21:41:20	Complete	0	8	00008	07FEB05:21:41:20	Complete	0	0
00009	07FEB05:20:16:00	Pending	1	98	00010	07MAR05:09:18:56	Complete	0	1
00011	07FEB05:20:50:08	Complete	0	6	00012	07FEB05:21:24:16	Complete	0	8
00013	28APR05:13:09:20	Complete	0	3	00014	07FEB05:21:41:20	Complete	0	1
00016	07FEB05:21:41:20	Complete	0	0	00019	07FEB05:21:41:20	Complete	0	0
00020	11MAY05:11:29:04	Complete	2	0	00022	16FEB05:18:27:12	Complete	0	1
00023	16FEB05:18:44:16	Complete	0	0	00024	03JUN05:20:07:28	Pending	0	21
00030	22JUN05:21:13:36	Pending	0	60	00055	04MAR05:09:55:12	Pending	1	65
00089	22JUN05:21:13:36	Complete	1	3	00501	16FEB05:13:20:00	Complete	0	3
00502	16FEB05:13:54:08	Complete	0	16	00503	30APR05:21:11:28	Complete	0	3
00666	01APR05:16:02:08	Complete	0	0	02000	06APR05:11:14:08	Complete	0	1
04444	22FEB05:08:59:44	Complete	6	68					

powered by  This request took 2.79 seconds of real time (v9.1 build 1461).

Figure 4: Edit Data Screen

In Figure 4 above, a click on the ID number will load the appropriate data entry form to access the record and make corrections. Corrections can either be based on the dynamic error report (next section), or they can be based on the instant error check implemented using JavaScript. For instance, ID 20 in the list above shows 2 errors. Upon loading the record and performing the Data Check, a separate Windows pops up listing the two problems.

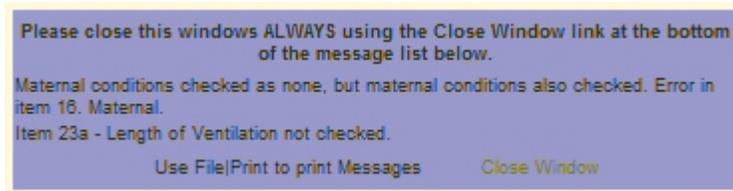


Figure 5: JavaScript Based Error Check

The two items are corrected. The record has to be checked for errors again. Only upon a successful check that no more errors are present, the data can be submitted. The result of the data submission is then displayed to the hospital user. For each item the variable, its description, its coded value, and its formatted value are shown. The top portion of the data submission result screen is displayed in Figure 6. Upon receiving the request for updating a record, the application server verifies the old record, flags it as old, then adds the new corrected record and flags it as the most recent record that should be used in all reporting functions. The record summary is printed by reading from the updated *CPQCC Master DB*, PUT statements are used to show the printed record detail.

Data Management

Result of On-Line Data Submission

ID 00020 for center 0000 submitted for year 2005 has been added/updated.
The submitted information listed below may be printed for your own records.

Record Status

Item #	Variable	Description	Coded Value	Meaning of Coded Value
-	_ReportDate	Last date and time of change to this record		13JUL05:13:52:00
-	ID	Network ID Number		20
-	HOSPNO	Center ID Number		0000
-	BYEAR	Birth Year		2005
1	BWGT	Birth Weight (grams)	2050 grams	
2a	GAWEEKS	Best Estimate of Gestational Age (weeks)	32 weeks	
2b	GADAYS	Best Estimate of Gestational Age (days)	5 days	

Figure 6: On-Line Data Submission Result (top part only)

ERROR AND QUARTERLY REPORTS

The error report does not only show errors, but also displays other data related to submissions the CPQCC Data Center has received from the member center (Figure 7).

Data Report

Center: 0000

Demonstration Center

Table of Contents

1. Completeness of Submitted Records
2. Detailed Error Report
3. Rejected IDs
4. Skipped IDs
5. IDs with large percentage of missing items
6. Submission Summary
7. Batches, File Numbers, and Dates with WWW submissions

Alternatively, you can [click here](#) to have a PDF version of the error report sent to your center's report contact via e-mail.

Figure 7: Top Portion of Error Report

Discussing the details of the error and quarterly reports is beyond the scope of this presentation. The reports are generated in three formats: as a MS Office/Excel spreadsheet, as an HTML document that is displayed to the user, and as a PDF document that can be sent to the user via e-mail. The required CPQCC error and quarterly reports had a very specific format that could not easily be implemented in ODS. It was easier to design a "skeleton" excel report certain parts of which are populated via DDE. The "skeleton" incorporates all needed special formats such that only data have to be added via DDE. To convert an Excel report into a PDF document, it is necessary to convert the report into a postscript file that is then run through the Adobe Acrobat Distiller. The postscript file is generated from within SAS using the %generatePS macro shown below.

```
%MACRO generatePS(hospno, which, local, quarter);
%GLOBAL CohortYear cpqccroot;
DATA _NULL_;
  FILE toexcel;
  PUT '[open("' &cpqccroot\DB Reports\create PS reports.xls" ')]';
  PUT '[WORKBOOK.SELECT("Parameters")]';
  PUT '[SELECT("R2C2")]';
  PUT '[FORMULA("' &hospno" ')]';
  PUT '[SELECT("R5C2")]';
  PUT '[FORMULA("' &local" ')]';
%IF &which EQ QTR %THEN %DO;
  PUT '[SELECT("R3C2")]';
%END;
```

```

    PUT '[FORMULA("'" &CohortYear" '")]';
    PUT '[SELECT("R4C2")]';
    %IF &quarter EQ 4 %THEN %DO; PUT '[FORMULA("4")]'; %END;
    %ELSE %IF &quarter EQ 3 %THEN %DO; PUT '[FORMULA("3")]'; %END;
    %ELSE %IF &quarter EQ 2 %THEN %DO; PUT '[FORMULA("2")]'; %END;
    %ELSE %IF &quarter EQ 1 %THEN %DO; PUT '[FORMULA("1")]'; %END;
%END;
    PUT '[run("gen' "&which" 'PS")]';
    PUT '[file.close(true)]';
RUN;
%MEND generatePS;

```

The macro is used to generate the PDF version of both, the error report and the quarterly report depending upon the parameter &which that has to be supplied when the macro is called. The line `PUT '[run("gen' "&which" 'PS")]';` calls a Visual Basic macro depending upon which report should be generated.

```

Sub genERRPS()
'
' genERRPS Macro
' 10/28/2004 by Beate Danielsen
'
'
Range("B2").Select
hospno = ActiveCell.FormulaR1C1
Range("B5").Select
localIndicator = ActiveCell.FormulaR1C1
If localIndicator = 0 Then
    mypath = "c:\projects\cpqccBETA\"
Else
    mypath = "c:\projects\cpqcc\BETA\"
End If
ChDir mypath & "DB reports\ERR"
Workbooks.Open Filename:=
    mypath & "DB reports\ERR\CNTR_" & hospno & ".xls"
Application.ActivePrinter = "HP DeskJet 1200C/PS on FILE:"
ActiveWorkbook.PrintOut Copies:=1, Collate:=True, PrintToFile:=True, PrToFileName:=
    mypath & "DB reports\ERR\in\CNTR_" & hospno & ".ps"
ActiveWorkbook.Close
End Sub

```

The Visual Basic macro generates a postscript file by printing to the HP DeskJet 1200C postscript printer using the FILE port. Adobe Acrobat Distiller is set up to convert any postscript placed in the `\ERR\in` folder to PDF. All these steps are performed on the application server when the user sends a request for an error report and do not require CPQCC staff. The quarterly reports are compiled four times a year, and then placed on the web server as static content.

SEND DATA/REPORTS VIA E-MAIL

As all reports are generated in real-time on the application server, and as the application server is a different physical location and not on the same network as the web server, it was necessary to set up a mechanism that allows hospital members to receive copies of the PDF versions of the error report. Besides the reports, it is also possible for each member hospital, to send a copy of their own most recent data as submitted to CPQCC to their hospital's designated data contact person. The format of the data can be specified by the user as one of MS Office/Access 97, MS Office/Access 2000, comma separated ASCII file, or SAS file. Anything that is sent via e-mail is encrypted, compressed and password protected using the macro `%sendEmailCenter`.

```

/* Send an automatic e-mail with requested item center's designated contact */
%MACRO sendEmailCenter(hospno);
%GLOBAL whichDocument cpqccEmail CPQCCDataEmail dbformat byears errorcode
    email sal name hlist0 hlist1 hlist2;
LIBNAME contacts ODBC DATASRC="CPQCC Contacts";
DATA email;
    SET contacts.hospital (KEEP=HospitalId SB_Salutation SB_Last_Name
        SB_Email RC_Salutation RC_Last_Name RC_Email);

```

```

RUN;
LIBNAME contacts;
%LET errorcode=0;
%IF &whichDocument EQ QTRreport %THEN %LET contactType=RC;
%ELSE %IF &whichDocument EQ report %THEN %LET contactType=SB;
%ELSE %IF &whichDocument EQ master %THEN %LET contactType=SB;
DATA _NULL_;
    SET email (WHERE=(HospitalId EQ &hospno));
    CALL SYMPUT('email',TRIM(LEFT(&contactType._Email)));
    CALL SYMPUT('sal' ,TRIM(LEFT(&contactType._Salutation)));
    CALL SYMPUT('name' ,TRIM(LEFT(&contactType._Last_Name)));
RUN;
%IF %BQUOTE(&email) EQ %BQUOTE() %THEN %DO;
    %LET errorcode=1;
    %IF &whichDocument EQ QTRreport %THEN %LET hlist1 = &hlist1 &hospno;
    %ELSE %IF &whichDocument EQ report %THEN %LET hlist1 = &hlist1 &hospno;
    %ELSE %IF &whichDocument EQ master %THEN %LET hlist1 = &hlist1 &hospno;
%END;
%IF &errorcode EQ 0 %THEN %DO;
    %LET pw=%STR();
    DATA _NULL_;
        SET cpqcc.mypw (KEEP=hospno EDSpw WHERE=(hospno=&hospno) READ=xx);
        CALL SYMPUT('pw',TRIM(LEFT(pw)));
    RUN;
    %IF &pw EQ %STR() %THEN %DO;
        %LET errorcode=2;
        %IF &whichDocument EQ QTRreport %THEN %LET hlist2 = &hlist2 &hospno;
        %ELSE %IF &whichDocument EQ report %THEN %LET hlist2 = &hlist2 &hospno;
        %ELSE %IF &whichDocument EQ master %THEN %LET hlist2 = &hlist2 &hospno;
    %END;
    %ELSE %DO;
        %IF &whichDocument EQ report %THEN %DO;
            X "&wzpath\winrar m -p&pw -afzip -inul -ep
              &cpqccroot\DBrepo~1\ERR\CNTR_&hospno..zip
              &cpqccroot\DBrepo~1\ERR\out\CNTR_&hospno..pdf";
            FILENAME out email FROM="diane@cpqcc.org" TO=("&email")
              SUBJECT="Center &hospno CPQCC Error Report" cc=("&cpqccemail")
              attach="&cpqccroot\DBrepo~1\ERR\CNTR_&hospno..zip";
            %LET hlist0 = &hlist0 &hospno;
            %END;
            [... more statements to get quarterly report/data ready for e-mail ...]
        %END;
    %END;
%IF &errorcode EQ 0 %THEN %DO;
DATA _NULL_;
    FILE out;
    %IF &whichDocument EQ QTRreport %THEN %DO;
    %IF %BQUOTE(&sal) NE %BQUOTE() AND %BQUOTE(&name) NE %BQUOTE() %THEN %DO;
    PUT "Dear &sal &name.:";
    PUT " ";
    %END;
    %ELSE %DO;
    put 'Dear CPQCC Member: ';
    PUT " ";
    %END;
    PUT "We are pleased to present to you ..." @@;
    [ ... more PUT statements that form the body of e-mail message ...]
    PUT " ";
    PUT "Sincerely, ";
    PUT " ";
    PUT "The CPQCC Data Center";
    %END;
    [... body of e-mail message for quarterly report/data ...]
RUN;

```

```

QUIT;
%END;
%MEND sendEmailCenter;

```

DATA CENTER STAFF SPECIFIC FEATURES

For CPQCC Data Center staff, upon logging onto the website, additional functionalities were implemented, e.g., the generation of a network report summarizing the number, completeness, and errors of all current submissions, overall and by member center, or the generation of application server activity report. For instance, the code snippet below is used to determine how many requests were handled by the application server during the last 15 minutes.

```

X "copy /Y &logfilefolder\%inputLog &logfilefolder\activeLog.log";
DATA _NULL_;
  INFILE "&logfilefolder\activeLog.log" ls=93 LRECL=93 PAD;
  INPUT @1 myweekday $ 1-3 @;
  IF myweekday IN ('Mon' 'Tue' 'Wed' 'Thu' 'Fri' 'Sat' 'Sun') THEN DO;
    INPUT;
    FILE "&logfilefolder\activeLogRED.log";
    PUT _INFILE_;
  END;
RUN;
DATA appserveruse;
  INFILE "&logfilefolder\activeLogRED.log" TRUNCOVER SCANOVER;
  INPUT @'ManageData' @;
  INPUT @1 actiondate $CHAR16. @18 actiontime TIME12.;
  starttime = INTNX('MINUTE',time(),-15);
  IF actiontime > starttime THEN OUTPUT;
RUN;
DATA _NULL_;
  IF 0 THEN SET appserveruse NOBS=nobs;
  CALL SYMPUT('appserveruse',nobs);
  STOP;
RUN;

```

WWW-BASED REPORTING

The CPQCC Data Center's annual paper reports were replaced by an on-line report mechanism. A demonstration of the reports is available at <http://www.cpgccreport.org> with the username cpqcc0000 and the password test.

Three components are currently available separately for babies weighing 1,500 grams or less (small babies) and babies weighing over 1,500 grams (large babies).

1. Tabulations of variables on which CPQCC collects information. An example for the form of tabulation is displayed in Figure 8. A hospital's data are compared to its data for the last year. They are also compared to all data for all CPQCC participants. A chart in the last column of each such table allows a quick assessment of areas in which the hospital has percentages lower or higher than the lower and upper quartile observed across all CPQCC members. These tables are produced using SAS and stored as static information on the web server.
2. Tabulations of standardized data allowing comparisons that control for important variations in a case mix a hospital treats. An example for this type of table is shown in Figure 9. If after controlling for case mix, there is a significant difference between a hospital's percentage and the average network percentage, the result is highlighted. These tables are produced using SAS and stored as static information on the web server.
3. Figures for all variables collected by CPQCC. An example for a dynamic chart is displayed in Figure 10. Each type of figure can be customized as the options in the navigation bar to the left indicate. These figures are generated in real-time using SAS/IntrNet.



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- All CPQCC Centers
- All Infants

OBSTETRICAL PROFILE

Infants over 1,500 grams born between 01/01/2003 and 12/31/2003
California Perinatal Quality Care Collaborative (CPQCC)

CENTER ID: 0000

	Center (N=400)			CPQCC (N Centers=48)			Center-Network Comparison
	N	%	Last Year's%	% Median	% Lower Quartile	% Upper Quartile	
Prenatal Care							
No	6	1.5	0.9	2	0	4	→
Yes	394	98.5	98.8	97	95	99	←
Unknown	0	0.0	0.2	0	0	1	→
Antenatal Steroids (for women who received prenatal care)							
No	333	84.5	86.1	80	72	88	→
Yes	61	15.5	13.7	16	11	26	←
Unknown	0	0.0	0.2	0	0	3	→
Delivery Mode							
Cesarean Section	172	43.0	40.3	53	48	59	←
Vaginal	228	57.0	52.1	47	41	52	→
Unknown	0	0.0	7.6	0	0	0	→

Figure 8: Example of Report Table



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Standardized Rates for Antenatal Steroids

Infants over 1,500 grams born between 01/01/2003 and 12/31/2003
California Perinatal Quality Care Collaborative (CPQCC)

CENTER ID: 0000

Center Infants: 29 Observed Events: 24 Observed Percent: 82.76

Standardized for	Expected %	95% Confidence Limits for Expected %		OE Ratio	95% Confidence Limits for OE Ratio	
		Lower	Upper		Lower	Upper
Prenatal Care	67.19	50.38	83.99	1.23	0.98	1.48

Notes:
Rows showing percentages that are significantly different from average California rates at the 5% level are highlighted.
Only inborn infants who were born at a gestational age of at least 24 completed weeks or at most 33 completed weeks are used in the above table.
Additional standardizations will be added to this table as they are requested.

Figure 9: Example of Report Standardized Table

CONCLUSION

CPQCC was able to successfully replace their previous paper-based and electronic data based system by a web-based data base management and reporting mechanism that has been well received with CPQCC member hospitals. Continuing the old way would have meant hiring 2 additional staff members, purchasing an additional Teleform license, and using voluminous paper and mail supplies. Moreover, as the data collection instrument expanded greatly in 2005, both in the number of items that are collected and the number of babies eligible at each CPQCC member hospital, resources at CPQCC participants would have had to be increased as well.

Converting to the web-based system channeled resources into the purchase of a SAS/IntrNet license, a web server, and an application server instead. CPQCC staff was successfully trained to guide the transition to a web-based system. On-line data collection for all centers has fully started earlier this year, and so far the results are promising in that fewer submissions per hospital are needed to obtain clean and usable data. Furthermore, all data appears to be submitted in a much timelier manner compared to previous years. Web-based reporting has turned into an important asset for CPQCC member centers.

Most importantly, CPQCC can now focus on its prime initial goals, namely using the data collected in their research to provide the best possible NICU care in California hospitals.

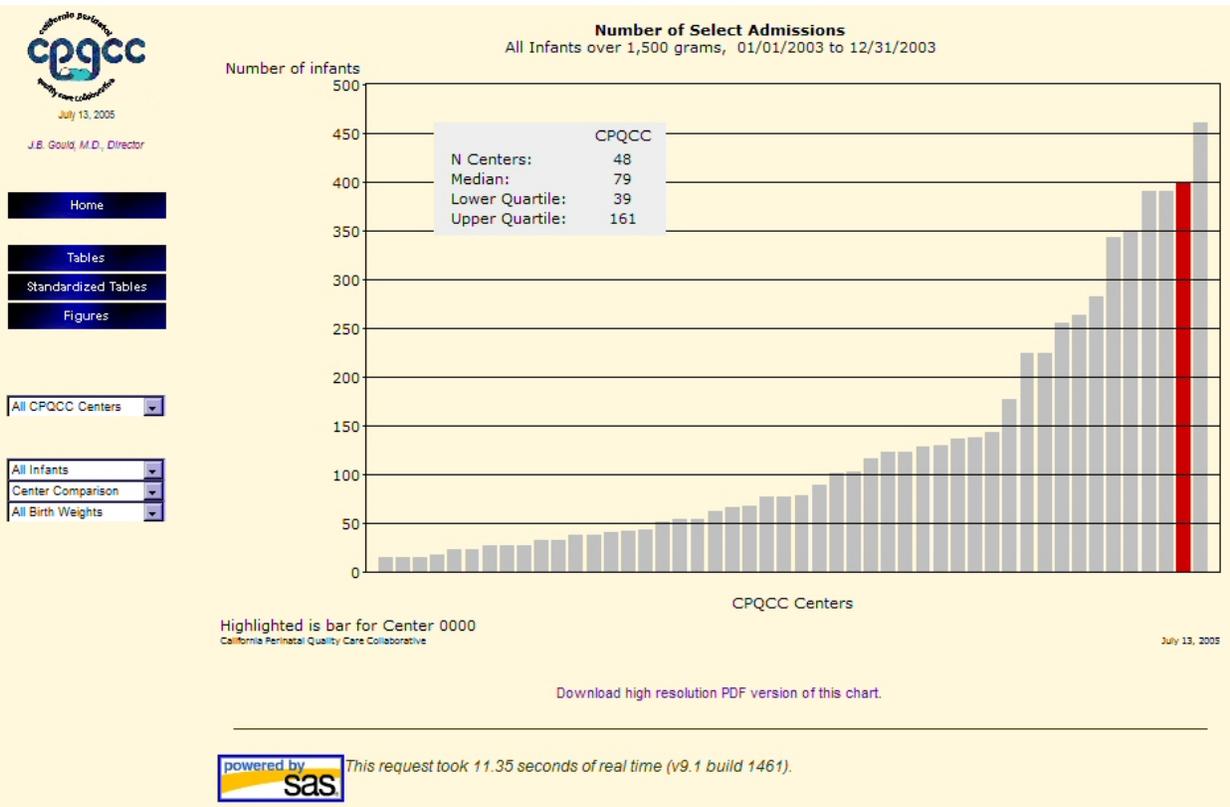


Figure 10: Dynamic Generation and Customization of Chart

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