

The Absolute Nitty-griddy of ODS Layout: Part I.

Annette I. Ladan, Centers for Disease Control and Prevention, Atlanta, GA

ABSTRACT

Evolving since early 2000, eHARS is a browser-based application designed to collect, store, and retrieve information on adult/adolescent and pediatric HIV/AIDS cases. eHARS promises to have great impact on HIV/AIDS surveillance, and will alleviate many repetitious and redundant tasks. Clearly, a vital aspect of the eHARS system is its reporting capabilities.

The current DOS-based HIV/AIDS Reporting System known as HARS provides the capacity for printing replicas of the hardcopy case report forms, but it is a bit crude and does not have the quality of the original paper case report forms. Nonetheless, health departments will still rely on a familiar way to view the data captured in eHARS. Both the adult/adolescent and pediatric HIV/AIDS case report forms have evolved over time and have undergone numerous formatting changes. These changes are not easily implemented and have not been reflected in the HARS version. The new, experimental procedure, ODS Layout, provides the capability to mimic these case report forms almost exactly.

The task of positioning data on multiple pages in a clear, concise, and logical manner is a daunting challenge, but the ODS Layout features make arrangement of the data elements simpler to program. With ODS Layout, objects are supported in the data step which allow the use of methods and properties. These methods and properties control the appearance, location, and most importantly, the layout of the form. ODS Layout supports two varieties: absolute and gridded. This paper will focus on the gridded layout which is the variety used primarily in the development of the eHARS case report forms.

KEYWORDS: ODS Layout, eHARS, HIV/AIDS

BACKGROUND

Monitoring the HIV epidemic relies heavily on reports of individual cases of HIV infection and/or AIDS for adults/adolescents and children. The application which facilitates this reporting is known as the 'enhanced' HIV/AIDS Reporting System or eHARS. This national, document-based surveillance system for HIV/AIDS is a collaborative effort being developed by the Statistics and Data Management Branch (SDMB) and the HIV Incidence and Case Surveillance Branch (HICSB). Both branches reside in the Division of HIV/AIDS Prevention (DHAP) in the Coordinating Center for Infectious Diseases (CCID) all of which are components of the Centers for Disease Control and Prevention (CDC), an agency of the United States Department of Health and Human Services (DHHS). eHARS encompasses all HIV/AIDS surveillance activities into one manageable system with fully accessible reporting capabilities. In turn, state health departments collect the data for entry into eHARS using two standardized forms: (1) Adult HIV/AIDS Confidential Case Report Form (ACRF) and (2) Pediatric HIV/AIDS Confidential Case Report Form (PCRF). Currently, all eHARS reports, including the facsimiles, are written utilizing the SAS® language. Over the past year, staff have developed techniques to enhance facsimile reporting using the new experimental feature, ODS Layout.

The eHARS facsimile reports will contain, for the most part, all of the detail embodied on the original case report forms. The most current version of the case report forms will serve as the foundation when developing and programming the source code. However, recreation of the original case form to the extent that it is virtually indistinguishable from the original in terms of page content, likeness, etc. is achievable, but sometimes difficult within the constraints of SAS®. Sites will be able to generate the facsimile case reports from within the eHARS application. Each facsimile case report form will have its own link and is automatically generated upon selecting a valid and unique stateno (state-assigned code), document UID, or eHARS UID. Data contained on the facsimiles are annotated [formatted] by using the eHARS format library where appropriate.

INTRODUCTION

This paper describes the SAS® version 9 feature ODS Layout and its use in developing the HIV/AIDS case report forms. For consistency, the term “facsimile” is used to refer to the HARS case report forms and will also be used throughout this paper when referencing the eHARS case report forms. By using ODS Layout, customized, detailed reporting and production of the facsimile case report forms is tedious, but attainable. Experimental with SAS® version 9, gridded layout has a top-down approach in which objects are placed on the form in a specified order, usually from left to right and then top to bottom. Columns and rows specify how each region is displayed on the page. State health departments deemed the facsimile reports as most critical in their ability to pinpoint important surveillance activities and highlight incomplete case reports.

WHAT IS ODS LAYOUT?

ODS Layout is a new, experimental feature in SAS® version 9 which allows the arrangement of text, tables and graphs on different locations of a page. There are two related but different methods of ODS Layout: *absolute* layout and *gridded* layout. Absolute layout is where you specify the exact position of each region using x and y coordinates; gridded layout performs like a table where each cell has a different layout and is dependent on the columns that are indicated for the proposed output. ODS Layout “gridded” offers more control and flexibility because of the specification of *region=*, *column=* and *column_span=* options. However, each method proves to be quite crucial for producing quality output using ODS Layout.

ODS LAYOUT SYNTAX

Object-oriented (OO) programming offers a new and powerful model for writing SAS® programs. An important property of object-oriented programming is the “object.” ODS Layout coupled with OO programming enforce the use of objects and their attributes to form the basis of all ODS Layout requirements. There are two ways to declare the object for ODS Layout.

1. declare odsout obj;

```
obj = _new_obj();
```

2. dcl odsout obj();

All necessary ODS initialization is performed using `obj = _new_obj();`. The `obj` variable communicates with the ODS system and remains active throughout the entire data step. The `dcl` or `declare` portion creates a local variable for use in the data step, but it remains undefined until the “`obj = _new_obj();`” or “`obj()`” statement is executed.

The SUGI paper entitled, “*Next Generation Data _NULL_ Report Writing Using ODS OO Feature*” by Daniel O’Connor explains in detail the many facets of objects and methods, so please refer to this detailed review. For our purposes, only a brief introduction to the syntax is discussed here. An excellent source for the object-oriented features of the data step is <http://support.sas.com/rnd/base/topics/datastep/dsobject/>.

Absolute layout is defined by specifying the following methods: `obj.layout_absolute` (*insert options here*); whereas, gridded layout is accomplished by using `obj.layout_gridded` (*insert options here*). Next, the **Start** option [`obj.table_start`, `obj.row_start`] and **End** option [`obj.table_end`, `obj.row_end`] statements tell SAS® when to start the code block and when to terminate the block. **ODS region** allows specification of the location of the report output.

The following ODS Layout syntax is used to begin the facsimile HIV/AIDS case report for Adult:

```
data _null_;
  set &dsn end=eof;
  by stateno;

  if _n_ = 1 then do;
    dcl odsout obj();
  end;
```

All necessary ODS initialization is performed using a declaration statement.

```
obj.open_dir(   name: "ACRF",
               label: "Adult Case Report Form");
```

The `obj.open_dir` statement allows access and processing of ODS statements.

```
obj.layout_gridded(  width:   "7in",
                    height:  "10in",
                    columns:   5,
                    column_widths: "1in",
                    column_widths: "1in",
                    column_widths: "1in",
                    column_widths: "1in",
                    column_widths: "1in",
                    column_gutter: "0.1in",
                    row_gutter:  "0.1in" );
```

Establishes a gridded layout which allows the arrangement of regions and associated tables into a series of rows and columns with different widths and heights.

When using the gridded approach the output areas are defined like a table with rows and columns. The output is then placed in the appropriate location in the table. The ODS REGION statement, at a minimum,

must specify the number of columns. Using the HIV/AIDS case report, the “**State/Local Use Only**” caption is displayed on the form by using the following code:

```
1 obj.region(column: 1, column_span: 4);  
2 obj.table_start( name: "StLclUse", Label: "State/Local Use", overrides: "style attributes");  
3   obj.row_start();  
4     obj.format_cell( text: "I. STATE/LOCAL USE ONLY", overrides: "style attributes ");  
5   obj.row_end();  
6 obj.table_end();
```



Let's break down this code line by line.

1. The **obj.region** statement tells ODS to span 4 columns and start in column 1.
2. The **obj.table_start** statement tells ODS to begin the table definition with the name “StLclUse” and to define the label as “State/Local Use.” The only purpose of these statements is to help identify the table. Although style attributes are indicated they serve no purpose in terms of report output.
3. The **obj.row_start** initializes the start of a new row.
4. The **obj.format_cell** statement displays the information surrounded by quotes on the form using the specified style attributes.
5. The **obj.row_end()** statement marks the end of the row. No other text is allowed after this statement.
6. The **obj.table_end()** statement concludes this table definition called StLclUse.

DESIGN PROCESS

Dividing the form into regions is the crux of designing the facsimile case reports. Each region reflects a particular segment of the form. These segments are then further divided into tables, columns and rows. ODS Layout allows a table with multiple columns and rows and with specific characteristics (style attributes). Each table of the eHARS facsimile case report begins with placing fields inside each table and then assigning style elements to each field or group of text.

The design is ideally a top-down, left to right process, starting with the first section, I. State/Local Use Only and ending with the Comments field. Each section of the form is defined by tables, continuing with rows and ending with putting variables adjacent to these fields.

The easiest way to tackle this process is to create a user-friendly design interface or empty shell that guides program development. This process is detailed below.

APPLICATION AND PROGRAM CODING

The life cycle/program development for the HIV/AIDS case report forms involves many phases. All phases of life cycle/program development from the preparation of the analytical dataset to customizing the form involve a reasonable knowledge of SAS®. The program development for the HIV/AIDS case reports involves six distinct steps:

- Prepare the analytical dataset
- Create the control dataset
- Assign/list variables to correspond to the ODS layout interface
- Create an ODS Layout interface (shell) similar to the ACRF and PCRF
- Customize the form
- Test, test, test

In this paper, preparation of the analytical dataset entails pulling data from the eHARS SQL tables for the express purpose of creating a SAS® dataset. This SAS® dataset will contain data on persons entered into eHARS for the purpose of HIV/AIDS case surveillance and reporting and consists of one record per person.

The control dataset extracts variables from the analytical dataset and represents a subset of specific variables used to generate the ACRF and PCRF. SAS® SQL tables are created and usage permits only one of these control datasets for report generation, ACRF or PCRF.

Steps 3 and 4, assigning variables and creating an ODS Layout interface go hand-in-hand. These two steps are done simultaneously and require much effort on the part of the programmer. Identifying the correct variables for the reports is critical to the final output and eliminates confusion before program development begins, hereby reducing reprogramming and misinterpretation of output results. The ODS Layout interface or the shell of how the report should look forms the basis of report design and guides code generation. In conjunction with these steps, there must be a clear understanding of the case report content and a general knowledge of ODS Layout terminology such as regions, columns, and override values.

Customizing the form involves writing the initial code without macros to get a clear picture of which ODS Layout options are needed. This initial code will result in syntax that is unyieldingly repetitive in nature and will ultimately require the use of macros to reduce code redundancy. Scanning the form to assess font sizes, textual differences, and colors are key factors that are important in customization.

Storage of the data in SQL poses constraints in that these default values for fields are often accepted which requires additional manipulation and the assignment of formats and labels in SAS®. Other critical factors which relate to the HIV/AIDS case reports are a full assessment of the HARS/eHARS variable equivalents and the astuteness to detect commonalities between the various case report forms.

Finally, thoroughly testing the SAS program is essential to successful ODS Layout development.

After the report has cycled through all six phases, it is time to validate the ODS Layout-generated case report form against the actual standardized case report form. This comparison is below. Please note that both versions are without field content.

Figure 1. HIV/AIDS standardized case report form – Adult, page 1

I. STATE/LOCAL USE ONLY	
Patient's Name: _____ (Last, First, M.I.)	Phone No.: () _____
Address: _____ City: _____ State: _____ Zip Code: _____	
RETURN TO STATE/LOCAL HEALTH DEPARTMENT	
U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES ADULT HIV/AIDS CONFIDENTIAL CASE REPORT (Patients ≥13 years of age at time of diagnosis)	
 Form Approved OMB No. 0924-0075 Exp Date 11/30/2005	
II. HEALTH DEPARTMENT USE ONLY	
DATE FORM COMPLETED: Mo. _____ Day _____ Yr. _____ REPORT SOURCE: _____	SOUNDER CODE: _____ REPORT STATUS: ☐ New Report ☐ Update REPORTING HEALTH DEPARTMENT: State: _____ City/County: _____
III. DEMOGRAPHIC INFORMATION	
DIAGNOSTIC STATUS AT REPORT (check one): ☐ HIV Infection (not AIDS) ☐ AIDS	AGE AT DIAGNOSIS: Years: _____ Months: _____
SEX: ☐ Male ☐ Female	ETHNICITY (select one): ☐ Hispanic ☐ Not Hispanic or Latino
RACE (select one or more): ☐ American Indian/Alaska Native ☐ Black or African American ☐ Asian ☐ Native Hawaiian or Other Pacific Islander ☐ White ☐ Unk.	COUNTRY OF BIRTH: ☐ U.S. ☐ U.S. Dependencies and Possessions (Puerto Rico) ☐ Other (specify): _____
RESIDENCE AT DIAGNOSIS: City: _____ State: _____ Zip Code: _____	DATE OF BIRTH: Mo. _____ Day _____ Yr. _____ CURRENT STATUS: ☐ Alive ☐ Dead ☐ Unk.
IV. FACILITY OF DIAGNOSIS	
Facility Name: _____ City: _____ State/Country: _____ FACILITY SETTING (check one): ☐ Public ☐ Private ☐ Federal ☐ Unk. FACILITY TYPE (check one): ☐ Physician, HMO ☐ Hospital, Inpatient ☐ Other (specify): _____	
V. PATIENT HISTORY	
AFTER 1977 AND PRECEDING THE FIRST POSITIVE HIV ANTIBODY TEST OR AIDS DIAGNOSIS, THIS PATIENT HAD (Respond to ALL Categories):	
☐ Sex with male ☐ Sex with female ☐ Injected nonprescription drugs ☐ Received clotting factor for hemophilia/coagulation disorder Specify: ☐ Factor VIII (Hemophilus A) ☐ Factor IX (Hemophilus B) ☐ Other (specify): _____ ☐ HETEROSEXUAL relations with any of the following: • Intravenous injection drug user • Bisexual male • Person with hemophilia/coagulation disorder • Transfusion recipient with documented HIV Infection • Transplant recipient with documented HIV Infection • Person with AIDS or documented HIV Infection, risk not specified ☐ Received transfusion of blood/blood components (other than clotting factor) First Mo. _____ Yr. _____ Last Mo. _____ Yr. _____ ☐ Received transplant of tissue/organs or artificial insemination ☐ Worked in a health-care or clinical laboratory setting (specify occupation): _____	
VI. LABORATORY DATA	
1. HIV ANTIBODY TESTS AT DIAGNOSIS: (Indicate <u>last</u> test) • HIV-1 EIA: _____ • HIV-1/HIV-2 combination EIA: _____ • HIV-1 Western blot/IFA: _____ • Other HIV antibody test (specify): _____ 2. POSITIVE HIV DETECTION TEST: (Record <u>earliest</u> test) ☐ culture ☐ antigen ☐ PCR, DNA or RNA probe ☐ Other (specify): _____ 3. DETECTABLE VIRAL LOAD TEST: (Record <u>most recent</u> test) Test type: _____ COPIES/mL: _____ *Type: 11. NASBA (Genentech) 12. RT-PCR (Roche) 13. bDNA (Chiron) 14. Other	
4. IMMUNOLOGIC LAB TESTS: AT OR CLOSEST TO CURRENT DIAGNOSTIC STATUS • CD4 Count: _____ cells/μL • CD4 Percent: _____ % First <200 μL or <14% • CD4 Count: _____ cells/μL • CD4 Percent: _____ %	

CDC 50-40A REV. 01/2003 (Page 1 of 2) - ADULT HIV/AIDS CONFIDENTIAL CASE REPORT -

Note:
The ODS
Layout
version
stops here
due to
page
limitations.
See Figure
2.

Figure 2. ODS Layout version, HIV/AIDS case report form – Adult, page 1*

I. STATE/LOCAL USE ONLY					
Patient's Name: Last: _____		First: _____	M. I.: _____	Phone No.: _____	
Address: _____		City: _____	County: _____	State: _____	Zip Code: _____
RETURN TO STATE/LOCAL HEALTH DEPARTMENT - Patient identifier information is not transmitted to CDC! -					
U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES		ADULT HIV/AIDS CONFIDENTIAL CASE REPORT			
		(Patients ≥ 13 years of age at time of diagnosis)			
Centers for Disease Control and Prevention		II. HEALTH DEPARTMENT USE ONLY		Form Approved CMB No. 0920-0573 Exp Date 11/30/2005	
DATE FORM COMPLETED: Mo. Day Yr. _____	SOUNDEX CODE: _____	REPORT STATUS: Date Reported: _____ Date Updated: _____	REPORTING HEALTH DEPARTMENT: _____	State: _____	
REPORT SOURCE: _____				City/County: _____	
				State Patient No.: _____	
				City/County Patient No.: _____	
III. DEMOGRAPHIC INFORMATION					
DIAGNOSTIC STATUS AT REPORT: AGE AT DIAGNOSIS: DATE OF BIRTH: CURRENT STATUS: DATE OF DEATH: STATE/TERRITORY OF DEATH:					
SEX: _____ ETHNICITY: (select one) _____ RACE: (select one or more) _____ COUNTRY OF BIRTH: _____					
RESIDENCE AT DIAGNOSIS, HIV: City: _____ County: _____ State/County: _____ Zip Code: _____					
RESIDENCE AT DIAGNOSIS, AIDS: City: _____ County: _____ State/County: _____ Zip Code: _____					
IV. FACILITY OF DIAGNOSIS			V. PATIENT HISTORY		
Facility Name, HIV _____ City _____ State/County _____ SETTING TYPE _____ Facility Name, AIDS _____ City _____ State/County _____ SETTING TYPE _____ _____ disclaimer on page 2 _____			AFTER 1977 AND PRECEDING THE FIRST POSITIVE HIV ANTIBODY TEST OR AIDS DIAGNOSIS, THIS PATIENT HAD (Respond to ALL categories): * Sex with male..... * Sex with female..... * Injected nonprescription drugs..... * Received clotting factor for hemophilia/coagulation disorder..... * Specify type of disorder..... * HETEROSEXUAL relations with any of the following: * Intravenous/injection drug user..... * Bisexual male..... * Person with hemophilia/coagulation disorder..... * Transfusion recipient with documented HIV infection..... * Transplant recipient with documented HIV infection..... * Person with AIDS or documented HIV infection, risk not specified..... * Received transfusion of blood/blood components (other than clotting factor)..... * Date of first transfusion..... * Date of last transfusion..... * Received transplant of tissue/organs or artificial insemination..... * Worked in a health-care or clinical laboratory setting..... * Health-care occupation.....		
CDC 50.42C REV. 01/2003 (Page 1 of 3) - ADULT HIV/AIDS CONFIDENTIAL CASE REPORT -					

The reproduction of the Adult case report form using ODS Layout is strikingly similar. In this particular instance the HIV/AIDS case report form infused with varying degrees of text, colors and fonts is reproduced

*The eHARS HIV/AIDS case report, 'ODS Layout' version is continuously revised as new SAS code is implemented and tested. Figure 2 represents an earlier version than what is presented in the poster.

with ODS Layout. Coding using the ODS Layout options is so flexible that there is no single 'right' way of producing output.

The entire SAS® code that produces the case report forms is lengthy and will not be reproduced in this paper. However, the poster illustrates key ODS Layout features pertaining to the creation of the ACRF and PCRF.

Careful attention to how regions/tables are defined is of particular importance in the creation of the HIV/AIDS facsimile reports. More distinct, smaller regions/tables provide more depth and precision. Smaller regions/tables also give more distinguishable divisions to a form and allow the use of more style attributes.

Section I. State/Local Use Only and Section II. Health Department Use Only are divided into 10 distinct tables. Depicted below is the SAS® results viewer illustrating the tables defined for Sections I. and II.

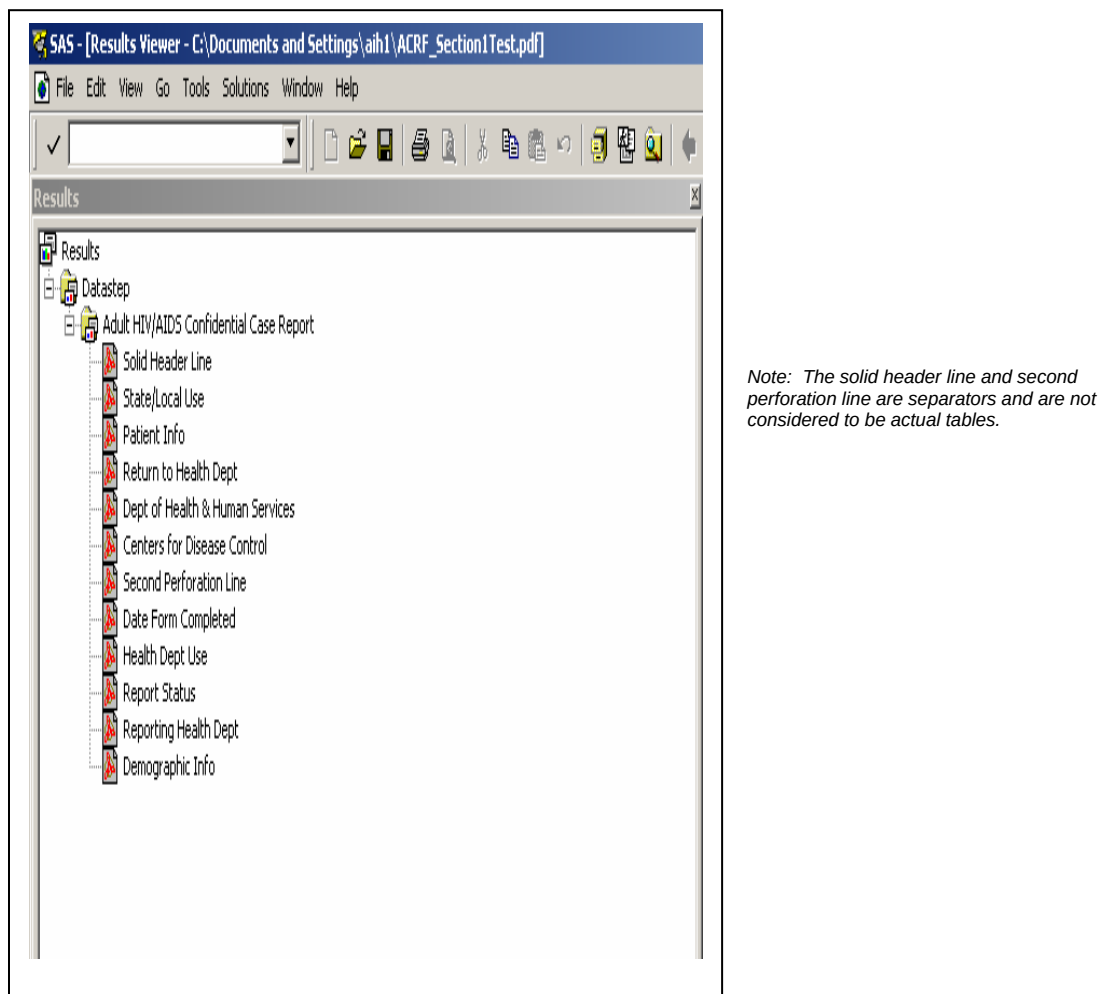


Figure 3. Table Definitions – Sections I and II.

LIMITATIONS

ODS Layout is an underutilized feature in SAS® version 9 and many of its options have not been thoroughly tested. One of the more regrettable limitations of this feature is that it will not generate RTF output. The gridded layout works well for PDF, but unpredictable results are apparent for HTML.

CONCLUSION

The absolute nitty-griddy of ODS Layout focuses not only on the methods, but provides insight into the generation of complex reports, such as the HIV/AIDS case reports. The gridded approach seems more viable for the HIV/AIDS case reports because this method offers more flexibility and hinges towards multiple page output. It does, however, take a considerable amount of time and effort to reproduce the case report forms, but it is well worth the endeavor.

DISCLAIMER

The findings and conclusions in this paper are those of the author and do not necessarily represent the views of the Centers for Disease Control and Prevention.

REFERENCES

Chen, Ling Y. (2005), Using v9 ODS LAYOUT to Simplify Generation of Individual Case Summaries, Rho Inc., Newton, MA, PSUG05, Po02-05.

Mays, Rich (2006), ODS LAYOUT is Like an Onion, SUGI 31, P159-31.

O'Connor, Daniel (2003), Next Generation Data _NULL_ Report Writing Using ODS OO Features, SUGI28, P 22-28.

SAS® Institute (2006), Methods for the ODS DATA Step Object,
<http://support.sas.com/rnd/base/topics/datastep/dsobject/>.

Schellenberger, Brian T. (2003), ODS LAYOUT: Arranging ODS Output as You See Fit, SUGI 28, P148-28.

ACKNOWLEDGMENT

Special thanks to Daniel O'Connor for the review of this paper and for sharing his example code. The code was invaluable in creating the initial HIV/AIDS eHARS facsimile case reports.

CONTACT INFORMATION

Your comments, feedback and questions are valued and encouraged. You may contact the author:

Annette I. Ladan
Centers for Disease Control and Prevention
1600 Clifton Road, N.E. (Mailstop E-48)
Atlanta, GA 30333
Work Phone: (404) 639-2991
Fax: (404) 639-8642
Email: aih1@cdc.gov

TRADEMARK CITATION

SAS® and all other SAS® Institute Inc. product or service names are registered trademarks or trademarks of SAS® Institute Inc. in the USA and other countries. ® indicates USA registration.

Other brand and product names are trademarks of their respective companies.