

# Implementing a Web-Based Case Reporting and Communication System Among Hospitals Reporting to the Birth Defects Registry in New York State

Patricia M. Steen, Ying Wang, Zhen Tao, Philip K. Cross, and Charlotte M. Druschel

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**Background:** The ability to use the Internet as a reporting tool has created important and timely changes in the way registries all over the world can collect data. This article provides a detailed description of the implementation that converted reporting hospitals in New York State from a manual, paper-based reporting system to an electronic, Web-based case reporting and communication system. The system usage was analyzed and the results are presented. **Methods:** The implementation process of the Web-based reporting and communication system included several steps: system introduction and orientation, system pilot testing, statewide campaign for implementation on a voluntary basis, statewide campaign for implementation on a mandatory basis, and system support and training. **Results:** The highly secure, user-friendly Web-based system was well perceived and accepted by the majority of the reporting hospitals and thus implemented for all reporting hospitals within a reasonable time frame. Currently, three fourths (115) of the reporting hospitals are using the on-line data entry method to submit reports, and one fourth (38) of hospitals are using the file upload method. Between July 2006 and June 2007, Congenital Malformations Registry staff had sent queries to 94 hospitals using the Web-based communication tools to request further information on the reported cases and more than half of these hospitals responded within 1 month. **Conclusions:** Successful implementation of the Web-based reporting and communication system required an effective implementation plan (including adequate training of users) and active interaction and cooperation between the Congenital Malformations Registry and the medical records personnel of the reporting hospitals.

**KEY WORDS:** case reporting, communication, congenital malformations registry, implementation, on-line, Web-based

Since the beginning of the 21st century, Web-based event reporting systems have been developed and implemented by researchers in the academic and medical environment around the world to facilitate the efficient collection of information from multiple geographically dispersed organizations.<sup>1-11</sup> The ability to use the Internet as a reporting tool has created important and timely changes in the way registries all over the world can collect data. The conversion from a paper-based, manual reporting procedure to a Web-based electronic system requires instruction that will ensure

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confidentiality, timeliness, and accuracy while maintaining the quality of the information submitted.

The New York State Department of Health (NYS-DOH) Congenital Malformations Registry (CMR) was established in 1982. All New York State Hospitals were mandated to report children 2 years or younger who were diagnosed with any structural, functional, or biochemical abnormality determined genetically or induced during gestation and not due to birth-related events. Until 2003, the majority of reporting hospitals submitted birth defect cases to the CMR, using a paper-based reporting system. The medical records staff of the reporting hospitals would identify a reportable case based on a provided list of reportable ICD-9 (*International Classification of Disease, Ninth Revision*) codes and manually fill out a paper-reporting form, which would then be mailed to the CMR. Some disadvantages of using this reporting process included data entry errors due to the illegibility of the handwritten report cards and delays in receiving reports. Moreover, filling in the cards by hand or a typewriter and then submitting the reports to the CMR were perceived as extra burdens on the reporting hospitals.

Over the past several years, CMR staff have developed a Web-based case reporting, data management, and communication system for the statewide birth defects registry in New York State, using NYS-DOH's Health Provide Network (HPN).<sup>12</sup> The HPN is an Internet-based communications infrastructure that utilizes the powerful Internet Secure Sockets Layer encryption technology to provide highly secure and efficient exchange of reporting, surveillance, and statistical and general information with its public health and healthcare provider partners. The HPN is a Health Insurance Portability and Accountability Act compliant system that supports reporting and information interchange pertaining to vital records and registries, disease surveillance and response, and health facilities management. The Secure Sockets Layer protocols authenticate the client and server to each other, enable encryption of sensitive information during on-line transactions, and thus ensure data integrity and secure data privacy.

As early as 2002, a few selected hospitals conducted pilot testing of the CMR's newly developed Web-based data reporting utility (the only on-line application developed at that time) to submit cases to the CMR. By January 2006, the CMR had converted all reporting hospitals statewide from a manual, paper-based reporting system to the electronic, Web-based case reporting, data management, and communication system. This innovative system provides a platform-independent environment for data submission, retrieval, analysis, and communication, offers a cost-effective solution for participating hospitals, and requires minimal technical as-

sistance from the CMR staff. Implementation of the Web-based reporting and communication system has resulted in more timely submission of cases to the CMR and promoted effective communication between the CMR and reporting hospitals.<sup>13</sup>

This article provides a detailed description of the implementation process that converted reporting hospitals in New York State from a manual, paper-based reporting system to the electronic, Web-based case reporting and communication system. In addition, the system usage (reporting and communication) is also analyzed and presented in this article. The information provided should help other birth defects registries/programs in planning steps and strategies that involve reporting hospitals and physicians to implement a Web-based reporting system.

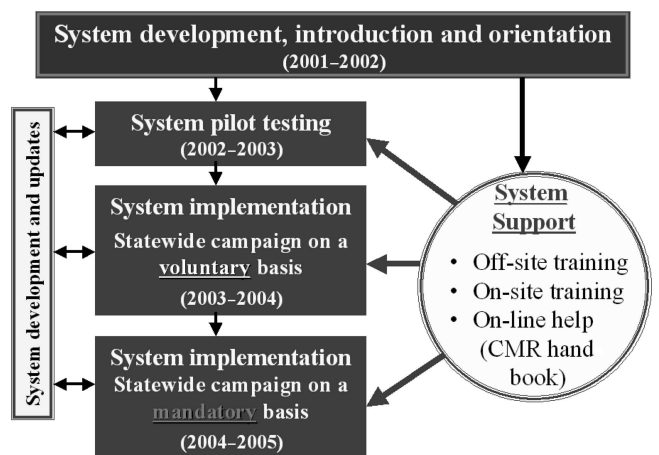
## ● Methods

The implementation process to electronic, Web-based case reporting to the CMR included several steps (Figure 1): system introduction and orientation, system pilot testing, statewide campaign for implementation on a voluntary basis, statewide campaign for implementation on a mandatory basis, and system supports and trainings.

### System introduction and orientation

Beginning in late 2001 and early 2002, hospitals were introduced to the CMR's newly developed Web-based case reporting system through a series of meetings that covered several health service regions in New York State including Western New York, Central New York, New York City, and the Capital District. Hospitals in

**FIGURE 1 ● The Implementation Process of the Web-Based Case Reporting and Communication System Among Reporting Hospitals in New York State**



each region were invited to participate in a daylong seminar on introduction and orientation of the Web-based reporting system, the procedures for obtaining secure access to the HPN, and the process for using the HPN to send CMR electronic reports on the Web. Slide presentations, handouts, and discussion periods were conducted by the CMR staff with expertise in computer information technology (IT) and on-line reporting using the HPN system.

The key message that was emphasized at these meetings was that the HPN reporting system provides a platform-independent environment for data submission, retrieval, and analysis, and offers a secure, cost-effective solution for participating hospitals. Authorized users can submit/edit data and view, update, or query case information dynamically from the CMR's database using any personal computer equipped with an Internet browser from any geographic area throughout the state.

### System pilot testing

To evaluate the newly developed Web-based data reporting system, five reporting hospitals agreed to participate in the system pilot testing. Hospital medical records personnel completed applications for on-line access to the HPN and CMR and then began the on-line reporting process in early 2002. The CMR staff provided step-by-step instructions for authorized users to submit the reports using one of the two Web-based reporting methods: on-line data entry that submits one report at a time using a fully customized on-line data entry form or file upload that submitted a batch of reports collected via their own IT system at regular intervals. Two testing hospitals used the on-line data entry method and three hospitals used the file upload method.

The file upload method required the cooperation of each facility's IT department for data preparation. The CMR staff provided detailed instruction for the user's IT department on preparing data according to a specific required data file format and file type. Hospital staff could then submit data to the CMR, using the file upload utility with the click of the file upload function button. Because the *ICD-9* codes used by reporting hospitals to code birth defects do not provide unique information for each reportable malformation, hospital staff using the file upload method must edit each case report, using the "edit unprocessed case reports" function button to add the specific narratives/descriptions for each malformation after the batch submission. Moreover, file upload hospitals needed to understand the difference between the "canned" narratives provided by their facility's software and the "specific" narratives required by the CMR.

Feedback and suggestions from the users of the pilot testing hospitals were discussed at the CMR's staff meetings, and modifications and program additions were made to the CMR's Web-based reporting system. For instance, an on-line help tool was developed and built into the on-line data entry form to assist users in entering the data fields correctly using appropriate data type and range. Hospital staff felt that it was imperative that they be able to keep track of a case report after it had been sent to the CMR. Thus, a function was added that allows hospital users to view their specific facility's "transaction log." The transaction log keeps a list of all cases reported to the CMR over the HPN by a user's hospital and logs information as to whether the case has been "added," "updated," or "deleted" by both the hospital users and CMR staff. It also lists the date and the HPN ID of the person who performed that action.

### System implementation on a voluntary basis

Once the system had been introduced to hospital personnel and the piloting of both reporting methods had been completed, all New York State reporting hospitals were notified in early 2003 by an e-mail that they should apply for on-line access to the HPN and the CMR and then submit reports using the CMR's Web-based reporting system. In the e-mail, the CMR staff also offered free in-house or off-site (by teleconference) training if needed. In addition, the CMR staff used each opportunity of hospital contact to encourage hospitals to convert from manual, paper-based reporting to the electronic, Web-based reporting. By mid-2004, 32 hospitals had voluntarily begun reporting electronically to the CMR using the CMR's Web-based reporting system through NYSDOH's HPN.

### System implementation on a mandatory basis

In September 2004, the CMR began pressuring hospitals that had not yet taken advantage of the CMR's Web-based reporting system to begin the electronic reporting process. E-mails were sent to the directors of each facility's medical records department explaining the procedure again and providing an electronic copy of the HPN access application and instructions for electronic submission. Each facility was told that the CMR would be "going totally on-line in the very near future" and that it needed to begin the application process immediately. A 2-week deadline was given to begin the application process, and then, if no correspondence had been received, another e-mail was sent, this time giving the facility a specific compliance date. Once a facility had personnel with HPN access, they were required to submit at least one report electronically to be compliant with this reporting directive. If a facility was small and reported

only a few cases each year and, therefore, had no current cases to report, it could submit a "test" case that would allow the CMR staff to confirm each facility's ability to use the HPN to report electronically. By January 2006, all reporting hospitals in New York State were using the CMR's Web-based reporting system to submit cases to the CMR. The CMR was no longer accepting paper reports from any facility by February 2006.

In late 2005, the CMR staff expanded the Web-based reporting system by adding the on-line communications functions that allow the CMR staff and hospital users to communicate via the Web browser or e-mail. These innovative functions allow the CMR staff to notify a hospital immediately if a specific case report has an unspecified diagnosis or lacks information and allows for the submission of this additional information through the HPN.

### System support and training

Medical records personnel at reporting hospitals had different levels of understanding when it came to the use of the Internet and electronic reporting. Some hospitals had been using electronic reporting for other health surveillance programs such as the cancer registry or submitting electronic birth registrations and were able to successfully follow the instructions that had been e-mailed to them at the time they received their HPN log-on IDs and passwords. Other hospitals required the CMR staff to conduct in-house training sessions to introduce the system and demonstrate the reporting procedures. Some users took advantage of telephone conferencing in which the CMR staff would open the Internet browser and the hospital users would do the same and then the CMR staff could "talk them through" the HPN-reporting process. Both the in-house training and the telephone conferencing included step-by-step instructions of all the function buttons on the CMR's Web site as well as a discussion of coding and reporting practices.

The CMR staff prepared a handbook that contains instructions for accessing the HPN, reporting to the CMR, and communicating with the CMR staff (ie, viewing and responding to the queries from the CMR), using the Web-based reporting and communication system. The handbook was made available on the CMR's home page. It can be referenced on-line or printed out for easy access. The handbook also includes information about the CMR, pertinent public health laws and regulations, Health Insurance Portability and Accountability Act of 1996, a list of reportable ICD-9 codes, and a description of the reporting criteria. In addition, telephone and e-mail supports are available to all authorized users (HPN account holders) from the reporting hospitals during regular business hours.

## ● Results

With the collaborative efforts of the CMR staff and the medical records personnel of reporting hospitals, an in-house Web-based reporting and communication system has been successfully implemented among the reporting hospitals in New York State. Table 1 summarizes the implementation process of the Web-based reporting system including the number of hospitals involved/participated and their contribution to the CMR (ie, the percentage of CMR reports annually), using the annual number of reports submitted by hospitals between January 1, 2002, and December 31, 2002. The 38 hospitals that contributed more than 50 percent of the annual CMR reports were invited to the regional meetings on system introduction and orientation. Out of 170 hospitals that reported cases to the CMR in 2002, the five hospitals that comprised 16.4 percent of CMR reports annually were involved in the system pilot testing and 32 hospitals that comprised 61.4 percent of CMR reports annually implemented the Web-based reporting system voluntarily.

Table 2 summarizes the usage of the CMR's Web-based case reporting and communication system, using the annual number of reports submitted by hospitals between July 1, 2006, and June 30, 2007. For the 153 hospitals that submitted reports to the CMR from July 2006 to June 2007, 115 (75%) hospitals that submitted about 58 percent of the reports are currently using the on-line data entry method and 38 (25%) hospitals are using the file upload method. Hospitals that have relatively large volume of reports ( $\geq 50$  reports monthly) and have a medical IT department for technical support preferred using the CMR's Web-based file upload method for case reporting. On the other hand, hospitals that have relatively smaller numbers of reports (<50 reports monthly) and hospitals that do not have technical support of IT personnel chose the CMR's on-line data entry option (data not shown).

Between July 1, 2006, and June 30, 2007, the CMR staff sent queries to 94 hospitals, using the Web-based

**TABLE 1 ● Summary of the implementation process of the Web-based case reporting system for the New York State birth defects registry, using the annual number of reports submitted by hospitals between January 1, 2002, and December 31, 2002**

Implementation phase	Number of hospitals targeted/ participated	% of Congenital Malformations Registry case reports annually
Introduction/orientation	38	54.6
Pilot testing	5	16.4
Participating voluntarily	32	61.4
Participating mandatorily	133	22.2



**TABLE 2 • Summary of the usage of the Web-based case reporting and communication system by hospitals reporting to the New York State birth defects registry, using the annual number of reports submitted by hospitals between July 1, 2006, and June 30, 2007**

	Hospitals		Percent of case reports to CMR
	N	%	
Reporting method			
On-line data entry	115	75.2	58.2
File upload	38	24.8	41.8
Total	153	100.0	100.0
Sent queries to hospitals			
Yes	94	61.4	86.7
No	59	38.6	13.3
Total	153	100.0	100.0
Number of queries sent			
≤5	55	58.5	22.0
6–10	21	22.3	24.7
11–25	13	13.8	25.2
>25	5	5.3	14.8
Total	94	100.0	86.7
Hospital average response time			
≤10 d	26	27.7	33.3
11–30 d	29	30.9	25.7
1–2 mo	18	19.1	13.1
>2 mo	12	12.8	12.5
No response	9	9.6	2.1
Total	94	100.0	86.7

communication (on-line query) tools to request further information on reported cases. More than half (55) of these hospitals received 5 or fewer queries and only 5 hospitals received more than 25 queries. With regard to hospitals' average response time, the interval between the CMR send-query date and the hospital response-to-query date, 55 hospitals (~58%) responded within 1 month and 26 hospitals (~28%) responded in 10 days or less. Nine hospitals that comprised about 2 percent of CMR reports never responded to the CMR's queries over the HPN and, therefore, required direct e-mail or telephone notification from the CMR staff.

## ● Discussion

The implementation of a Web-based data reporting and communication system for the New York State CMR transformed authorized users' computers into efficient workstations for submitting data rapidly and accurately without the need for additional special hardware and with minimum technical assistance. This highly secure, user-friendly, menu driven system was well perceived and accepted with little hesitation or resistance by the majority of reporting hospitals. Thus, the imple-

mentation process proceeded smoothly within a reasonable time frame.

System testing among pilot hospitals was a very important step in the implementation process. Feedback and comments from the users were very helpful in improving the system. A joint effort for developing an on-line help menu and training protocols, identifying barriers, and finding solutions for overcoming these barriers during the implementation process was made by both the CMR staff and the pilot hospitals. An example of a problem that was identified was the realization that many users had little experience with Internet technology and on-line tools. Extensive in-house and off-site trainings and the development of the on-line CMR handbook and on-line help menu assisted users in overcoming this barrier. Another common problem encountered was that not all hospital medical records departments had Internet access available to their staff. Some hospitals had to make decisions as to which individuals would receive computer upgrades or Internet access. These administrative decisions caused delays and some procrastination for some facilities. Moreover, some users expressed concerns about the security and privacy of the information submitted on the Internet. The CMR staff provided adequate education on these issues at regional meetings and training seminars.

Pursuing and convincing the hospitals that contribute the majority of CMR reports annually to accept the new system implementation were the top priority of the CMR staff. Using the limited resources available, the CMR staff conducted regional meetings to introduce the new system to small groups of hospitals that comprised more than 50 percent of the CMR reports annually. Following this strategy, the CMR staff successfully converted 37 (out of 170) hospitals that comprised more than two thirds of CMR reports annually from the manual, paper-based reporting system to the electronic, Web-based reporting system within a 2-year period.

Web-based communication systems have been developed recently for improving communication between patients and their clinics and physicians and providing quality healthcare.<sup>14–20</sup> However, the development of Web-based communication between the public health professionals and healthcare providers for health surveillance programs had been slow. The expansion of the CMR's Web-based reporting system to include the interactive on-line communication tools during the system implementation process provides a cost-effective way of communicating between the program staff and the medical records personnel of reporting hospitals. This innovative system enables the CMR staff to communicate with the hospitals on-line with regard to submitting reports in a timely manner. An evaluation of the utilization of the Web-based communication system showed that although many

hospitals are actively involved in on-line communication and respond to the queries sent by the CMR staff in a timely manner, there were quite a few hospitals that took month(s) to respond or never responded. The CMR staff is working on plans to improve communication with these hospitals.

One consequence of using a Web-based reporting and communication system is that, because of the relatively high staff turnover rate in medical records departments in the reporting hospitals, the CMR staff must be readily available to train and help new users regarding log-on procedures as well as reporting and coding issues. In addition, hospital users need to be notified whenever there is a need for system updates, upgrades, or changes to avoid interruption of the normal data entry or file upload process.

Although the use of the Web-based reporting and communication system has been the main impetus in the improvement of reporting timeliness and completeness, the commitment of the CMR staff to continually monitor reporting and communicate on a regular basis with hospital personnel allows these numbers to continue to improve. As ongoing efforts to improve the data quality of the case reports, the CMR staff is currently working on developing new applications to improve and expand the system.

In conclusion, successful implementation of the Web-based reporting and communication system required an effective implementation plan (including adequate training) and active interaction and cooperation between the CMR and the medical records personnel of the reporting hospitals. This highly secure and user-friendly system was well perceived and accepted by the majority of the reporting hospitals and thus implemented for all reporting hospitals within a reasonable time frame. The utilization of a computer system like the Health Provider Network and a plan for development that includes testing and program implementation could be adapted by a variety of public health programs to facilitate surveillance activities through improvement in the timeliness, accuracy, and completeness of reporting.

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