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# MODERN TECHNOLOGY
# FOR
# CIVIL REGISTRATION AND VITAL STATISTICS:
# the case of the United States of AMERICA

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# Modern Technology Applications

## BACKGROUND

The question of advancements in technology and their application to the processes involved in civil registration and vital statistics in the United States is one which has been addressed over the past
decade. As a decentralized national civil registration system, activities in the United States are pursued by the National Center for Health Statistics (NCHS) which is the national vital statistics office, in conjunction with the independent civil registration systems of the individual states.

Accomplishments during this period, and current ongoing activities in the implementation of new technologies in the areas of civil registration and vital statistics are focused on record processing, storage and retrieval; electronic transmission of information; and, the preparation, analysis and reporting of vital statistics. The use of new technology in the area of vital statistics has been implemented over a long period of time at both the national and state levels.

This has included the coding and data entry of selected demographic, health and geographic data from the registration systems' records into a machine-readable format. The data are then processed to prepare vital statistics using various computer software both on mainframe and microprocessor (PC's) computer systems. The use of new technology in addressing this component of the states' systems has been a longterm application in the area of vital and health statistics in the United States.

Conversely, the implementation of new technology in the operational areas of the individual states' civil registration systems has only recently become a major activity. There are a number of reasons for the limited applications which, until now, had been employed in the use of modern technology for civil registration functions. These included 1) the lack of resources to redirect existing registration functions from manual operations to automated methods; 2) difficulties in obtaining staff, training and equipment in order to apply the technology; and, 3) limited access to the available technological resources due to high costs of equipment and technical support services.

With regard to item 1., the main problem had been the transitioning of the vital records data to machine-readable format. The large volumes of records involved require both extensive coding and data entry operations. The resources needed to undertake these efforts can, in many areas, be extensive. This leads to the difficulties cited in item 2., namely, the need to obtain increased staffing levels for coding and data entry

activities as well as the necessary equipment to perform these operations. Where the record volumes to be automated, including current and stored birth and death records, are large these resources are essential. And, training and technical services become necessary to implement an effective program. The result is, as noted in item 3., that the related expenses often exceed available funds. When these items were not a problem for a particular state registration system in the United States, new technology developments were applied to selected components in the civil registration processing system.

One of the earliest technological applications used was the replacement of hardcopy records with microforms (roll microfilm or microfiche). Most of the states in the United States have transitioned from hardcopy civil registration documents to the use of microforms for the preservation and storage of vital records. Records which have been stored for a long period of time, or stored in an inadequate environment often end up with faded written information on the records. Microfilm processing of the records not only provides for the better preservation of the records, the filming process also improves the quality of the written items on older records. This helps maintain the registered record information in a readable format. This process also significantly reduces the amount of space required to store the records. One role of microfilm can store up to several thousand documents. However, current modern technology in optical disk systems, which is described below, is replacing the microform systems in many of the states' registration systems.

During this early transition period, a computer application was developed for the automation of birth and death indexes. In this case, data entry was done for selected information from the registration ledgers and put into machine-readable format. Computer software was then developed which provided an automated approach for searching through the index records now stored on a computer. This automated index search system provides the exact location of specific registration records stored either in a hardcopy paper form or on microfilm. This also produces an effective method for the record retrieval and copy preparation in response to requests for a legal certified copy or certification of the vital event. Rather then manually searching through ledgers or document files, the record identification number and storage location is automatically identified. Record retrieval is greatly improved by this method.

Depending on the amount of information that is placed in the machine-readable format in preparing the computerized indexes, this application also allows the automatic searching for, and printing of copies of the vital event. This is primarily used by states in the United States for birth and death short-form certifications. In instances where a request for the record copy

is for purposes such as to verify a child's age for school entrance, or to obtain a working permit, or to verify the time or place of death to obtain family benefits this type of automated certification processing is a very efficient method. It not only provides a legal form to the requesting individual, it also minimizes the amount of work required in processing the request to prepare the document and issue it on a timely basis.

This application was first used in the New York State registration system in the early 1960's. The data elements for the automated indexes for births and deaths included the record registration number, the individual's name, date and place of occurrence of the event, and the names of the parents. When a request is received for a copy of a birth or death record, the request is reviewed to determine if a short-form certification is appropriate. The record is then processed on a PC, with the record search, retrieval and printed copy prepared automatically.

Subsequent advancements in technology have provided various types of retrieval systems to store, search, retrieve and access the records maintained in the microform format. Computer-assisted microfilm systems (CAM) have been developed which allow for the indexing, storage, retrieval and printing of microfilm records. This type of system uses computerized indexes to locate the specific record requested and incorporates an automated mechanism which automatically retrieves the microfilm and then places the specific record on a computer monitor for review prior to printing.
This technology allows for an automated procedure to be developed based on previously manually processed microfilm records.

The momentum for registration systems in the United States to move toward automated systems reflects the increasing functions and responsibilities that civil registration represents. There is a significant need to conduct monitoring and surveillance of health issues using data and information from the civil registration system for national, state, and local health objectives. This has become a major issue in the decentralized national civil registration system. The national vital statistics office relies on the reporting of vital events from the individual state registration systems, and has experienced delays in the preparation of national vital statistics due to manual processing operations.

In this latter issue, reporting of vital events from the local registration offices to the state's central office for vital statistics is timely, but the subsequent processing requirements -coding, data entry, corrections and amendments - have caused significant delays in the preparation of vital statistics at the state level. These problems have direct impact on the national vital and health statistics program. To address these issues, the

national statistical office (NCHS) has established a committee of state registration and vital statistics representatives. This committee has recognized that current processing methods in registration must be reconfigured. The implementation of the new technology to meet these needs is designed to meet the stated objectives for future needs of vital and health statistics data and information, and to improve registration activities.

In addition to providing more timely vital and health statistics data, the need for more accurate and timely vital registration records has increased. As more government and private agency sponsored services are implemented, the need for the public to provide legal documents to receive benefits has increased. Vital records are essential to meet these needs. Automation provides for accurate and timely registration services to be processed. The movement by the states in the United States in the use of modern technology to improve civil registration activities has been initiated by, and directed to both of these issues.

The availability of more powerful personal computer technology, expansion of electronic communications networks nationwide, and the growth in data automation through various software development has resulted in the automation of registration activities among the states. At the national level, the new technology for electronic dissemination of data is being developed so that information can be received from the states' systems at the same time it is received at the state level from the reporting source. Electronic transmission has made significant improvements both in the quality and timeliness of the data. The costs associated with these new technological advances has reduced significantly over time, and can now be incorporated in most systems.

## RESTRUCTURE OF THE STATES' SYSTEMS

The re-direction of the states' civil registration systems with the use of new technology is based on three phases for implementation. These are currently underway and include:

**I. Restructuring of the states' current civil registration and vital statistics systems.**

> The primary function necessary to restructure the current states' registration systems in the United States is to change from a batch record processing mode to an on-line computer-based system within each state. This new approach, which is currently being implemented for birth and death records and will, at some later point in time, be used for other vital events. This allows for birth and death records to be prepared at the reporting source in an electronic format, with

direct on-line linkage to the state's registration system. This provides immediate access to the vital events both for registration and vital statistics purposes.

The primary mode of operation is through microprocessors (PC's) with modems which allow for direct data transmission to the state's computer system. The PC's have software which display the record format of the birth or death record on the PC monitor. Each data item is then entered by staff at the source location (hospital, clinic, or funeral establishment). The PC software also contains editing capabilities to control proper coding and information at time of entry. At facilities where the original data is on a mainframe computer, software is available which extracts the appropriate registration record data from the medical record, and goes through the same process as the PC software. Transmission of the data can be done directly from the mainframe computer system.

## II. Development of initiatives to improve current activities and prepare for transition to the new electronic system.

Initiatives underway to improve current activities involve the implementation of electronic birth and death certificates through hospitals, nursing facilities, and funeral establishments. This improves the timeliness and quality of the data. There is also the move to standard coding and record processing techniques which allows for the integration of each state's system with the national vital statistics system and systems in other states. To maintain updated information for both registration and statistical purposes, there is a need to incorporate record modifications as a result of corrections or amendments on an interactive basis as they are received into the system. These changes are part of the new electronic registration system.

## III. Implementation of necessary actions to address current problems.

One problem relates to issues of confidentiality and security of the registration information in the new electronic format. In the United States, each state has different requirements related to access to registration information. Some states have an "open records" law, which allows access to the records or information by anyone. Most states, however, limit access to the registration record or information to the

related individual or family, or to official agencies.

To address this issue, it is necessary to provide
security methods in the electronic transmission of the
data in the registration system. The technology that
addresses this component is the use of encryption
modems. These modems, which are used in the
transmission of the data from the place of occurrence
of the vital event to the state registration system,
encrypts the information at the time of transmission
i.e., the information is converted to a non-readable
format. At the receiving end of the transmission i.e.,
at the state registration system, the modem de-encrypts
the information to the original written format. In this
way, any illegal access to the electronic transmission
system cannot obtain access to the registered data.

## TRANSITION TO AUTOMATED SYSTEMS

The first phase in the transition to the automation process is to
have in place an effective administrative and operational
registration program. Given this, the type of automation
technology appropriate to modify the system then becomes a
critical decision in developing efficient, timely and responsive
registration functions. If the transition to an automated
registration system is from a vital statistics system which is
computerized, the data and processing resources need to be
expanded to include registration activities. The completeness and
quality of the computerized data files must also be evaluated to
assure that the legal aspects of the records are complete and
accurate.

Computerized processing of vital records in the United States has
been primarily in the area of vital statistics. Each vital record
contains basic demographic data as well as medical and social data
relevant to the specific event. Standard data are collected on
these records in the individual states for use by the national
vital statistics office. In addition, other data of interest to
the specific states are collected, then the data are coded and
entered into machine-readable format for statistical use. In some
states, the legal data is also entered and becomes the primary
data source for the operational aspects of civil registration
functions.

The data are used in the preparation of state vital and health
statistics reports, for conducting research and quantitative
analysis, and for health program direction and evaluation. The
data are stored on magnetic tapes or on disks and are provided to
the national office (NCHS) for use in preparing national vital
statistics. The transition from these storage methods to the
electronic transmission system from 1) the reporting sources of

the vital records to the states and, 2) from the states to the national vital statistics office is a major application of the new developing electronic technology in information dissemination.

There are a number of factors to consider when addressing the questions related to the establishment of automated systems for use in the registration process. First and foremost are the characteristics of the current registration program. Record volume, the number of daily transactions such as record corrections and amendments, indexing, security, and data integrity all dictate the direction for establishing an automated system. Currently, automated systems development for civil registration activities include computer-based systems, optical disk systems, and computer-assisted microfilm systems. Each of these systems provides unique functional capabilities, and requires a complete review and evaluation prior to system selection and implementation in the identified areas.

## TECHNOLOGY USED IN REGISTRATION SYSTEMS

The  expanding technology in computer software and hardware, and in other media such as optical disk and microform systems, allow for mass storage and rapid access and retrieval of information. Subsequent processing of transactions against the established database, the preparation of record copies and reports, and the compilation of related statistics are more efficient and economical then in previous manual systems. New technological methods are now more frequently used in many states for implementation in their civil registration systems. The utility and effectiveness of automation in terms of costs, operational productivity and timely system responsiveness to requests for vital statistics and registration services are major reasons for re-directing programs to automated registration systems.

### *Computer-Based Systems*

In developing computer-based systems, a major consideration is the data entry function. In a registration program which is totally paper-oriented, data entry can be a significant cost and requires an extensive time period in getting the system up and operational. One strategy is to implement the system by using only current records, and records from selected past years for initial placement into the system. The older records selected should represent those requiring the highest level of processing activities. This approach gives immediate benefits in reducing the current workload requirements in registration processing activities, and for building a fully automated system for the future.

Where previous years of data are already in machine-readable form that is, are stored on magnetic tapes or disks, the movement to a

fully operational computer system becomes a more appropriate option. In the United States, the original data entry to machine-readable formats was developed for vital statistics purposes only. These files, as noted above, were subsequently used to prepare automated indexes for record searching, and for the preparation of short-form certifications for births and deaths. These types of data files provide for more timely implementation to the automation of their civil registration activities.

Within a computer-based system, record storage and retrieval, indexing, record searches, corrections, and the preparation of record copies for transcript copies or certifications are quickly and easily processed. The security of the data is also at a maximum level since access is limited to those who have proper authorization (personal identification and password codes) to enter the computer system. Such systems can be developed on PC's, in a local area network (LAN) computer system, or on a mainframe computer. The system selected depends on the capability and structure of the registration system for implementation and related processing.

Personal computers and data servers now have multiple gigabytes of disk storage, and operate at very high speed (66 mhz). They also contain networking, electronic communications, and CD-ROM (optical disk) capabilities. These types of equipment have had significant cost reductions and continue to decline as more technology is introduced. Computer systems are now down to reasonable costs, with equipment capacity up for processing most civil registration activities. New computer technology has also produced highly "user-friendly" software for the operational activities which minimizes training efforts required for registration staff.

### Optical Disk Systems

An alternative to the computer-based systems, particularly as this relates to large existing paper-based systems where data entry would not be feasible, is the use of optical disk. In this type of system, large volumes of records can be electronically scanned and placed on an optical disk. Several states have moved their registration activities to this technology in recent years. An electronic index is created at the time of scanning, allowing search and retrieval of records at electronic speed. Optical disk gives an exact replica of the original record as opposed to the computer-based data entry system where only selected data are in the system in digitized form. In addition, storage capacity on a single disk, 12 inches (30.5 cm) in diameter, can range up to a million records.

Optical disk provides for massive storage in minimal space; provides for efficient retrieval of records; and, produces exact

copies of the original record. New technology has recently been developed which now allows for corrections and amendments to be made directly to the records on the disk. Previously, optical disk applications had only the "write-once, read-many" (WORM) disk technology, where changes could not be incorporated onto the existing record. A second disk containing the corrected record had to be created and linked to the disk with the original record. The new technology for optical disks now permits changes to be made on the disk.

For registration purposes, this accommodates incorporating amendments and corrections to the original stored records and eliminates the need for a second disk for processing purposes. In the optical disk format, however, data cannot be directly processed to produce related vital statistics. This is the advantage of the computer system; all of the data in the computer can be processed to prepare reports, statistical summaries, conduct research utilizing the computer database, and perform most of the civil registration functions. The computer system also allows for direct electronic data transmission.

## *Computer-assisted Microfilm Systems*

Another technology which has been developed for some time, with continuing upgraded modifications, is the computer-assisted microfilm (CAM) system. This system takes advantage of the fact that many of the civil registration systems in the United States have had manually operated microfilm systems. Microfilm technology has been in existence for many years and has been implemented in many other countries as well. Over time, enhancements have been made by incorporating electronic technology into the system.

Existing records stored on microfilm, either in roll form or microfiche form, can be integrated into a computer-assisted system. This type of system allows record processing to take place at significantly higher speed then the original microfilm processing equipment. Through electronic indexing, the microfilm can be searched and records retrieved very quickly. Where microfilm has not been previously used and documents still remain in hardcopy form, the documents can be filmed and placed into a CAM system. This represents a third option, the first two being computer and optical disk systems. In the United States, the latter two technologies are now the primary applications for improvement of the states' civil registration systems.

Processing for statistical purposes and related analytical usage is not practical with microfilm images. Also, corrections and amendments to the record, since it is on film, are not as efficient as in the computer system or optical disk system. Separate microfilm copies would be required and matched by changes in the index to the original record film source. Since the system

has a microprocessor, search and retrieval of registration documents is, however, at electronic speed. This type of system, as with optical disk, is best suited where the activity is focused primarily on registration functions; data processing for statistical purposes and for report generation and analytical uses of the data are best accomplished in the computer-based systems.

## *Comparative Differences of the Systems*

Because of the differences in the technologies described above, it is essential that prior to selection of the technology for implementation, the expectations and purposes of the registration system must be fully described. Where record storage and processing for registration functions is the major goal, optical disk or CAM systems can provide an effective system for operations; where there is need for data processing to prepare vital and health statistics, and for epidemiological and research purposes in addition to the registration functions the computer-based systems provide greater flexibility.

It is clear that technology exists to bring civil registration into an automated environment, and is the direction underway in the United States. System costs for software, hardware, equipment maintenance and training have been reduced to levels where these items can be very cost-effective in a registration program. Most states are moving in this direction. Where such systems have been implemented, the resultant cost-savings, timeliness of processing, staff efficiency, and applications development have significantly outweighed the initial investment.

The current national committee established for development of automated registration systems supports a nationwide system to be operational by the end of this decade where electronic birth and death records are transmitted from the reporting source directly to the state registration office. Following processing of the records, data are transferred electronically via modems to the national statistical office. This electronic media could, at some point in the future, result in a paperless civil registration system among the individual states.

One example is the current electronic transfer of vital events occurring in a different state then the state of residence of the individuals. The original method was for each state to send copies of records recorded for non-residents to the state of residence. This was a major task, with fifty (50) states involved in the process, and resulted in delays or non reporting of such events. This reduced the accuracy of each states' resident vital statistics profiles. The shifting of the manual approach to the electronic transmission of the records has resulted in timely and complete reporting of resident data in each state. Paper copies are no longer required with this approach.

## APPLICATIONS

The application of modern technology to the administrative and operational activities of civil registration has in recent years received major attention in state programs in the United States. In the past, computerization had focused primarily on the vital and health statistics and research components of state vital statistics systems, with registration functions continuing in a manual mode. Some developments in the automation of registration activities have occurred over the years as described above, but most of these efforts have been directed to the solution of specific problem areas such as record storage or indexing.

## Registration Functions

More recently, automation has been extended to encompass all of the operational functions of civil registration with the goal of developing completely automated state registration systems. The United States is very close to realizing this goal, with many states now directing major resources to implement such systems. Over the next five years, most states in the United States will have significant portions of their registration activities fully automated, with several approaching a "paperless" system.

Increased demands on the registration system for services and for vital and health statistics data has resulted in the states moving toward fully automating civil registration functions. The directions taken in various states in the United States differ in part due to their unique requirements, the present status of the existing system, and to some extent due to availability of staff, equipment, and training. These are limitations to implementing computerized systems, but decreasing costs for computer equipment, and user-friendly software have made such development feasible and affordable. Specific areas of the registration programs for automation include data entry, storage and retrieval; record indexing; certification forms, amendment and correction of records; and data transmission.

### *Data Entry, Storage and Retrieval*

Several approaches have been taken in resolving the problems associated with entering data from vital record forms. Traditional processing methods have the forms completed in the field, and submitted to the central registration office for coding and data entry. This requires substantial resources in terms of staff, equipment and storage space. As these resources become more costly, alternative methods of getting the data into an automated format have been implemented.

One method has the coding and data entry occur at the source of

the event such as the hospital or clinic. Records can be
transmitted electronically over telephone lines from these sites
or, the data can be copied and submitted to the registration
office on floppy disks. This process employs microcomputers (PC's)
located at the site. The PC contains a software package which
displays the certificate format, and  performs certain editing
functions. Staff enter the information into the form displayed on
the monitor, which then undergoes an editing process. Edit checks
include such items as verifying that data fields contain only
appropriate alpha or numeric data; codes for selected variables
are in the proper range; and variables such as age, date of event,
and residence are accurate.

This approach eliminates the need for coding and data entry staff
at the registration office, and minimizes the need for interchange
of certificates with the hospitals or clinics for corrections or
incomplete data. This significantly improves the timing and
availability of the data both for registration and vital
statistics purposes. Estimates at the  central office level
indicate that data entry requirements are reduced from 40% to over
60%; coding is reduced by 50%; and, the timeliness and
availability of the data is increased by nearly 80%. These
percentages reflect differences between manual and automated
processing techniques.

Costs of the equipment and the software for this type of
application varies depending on the volume of records. Inclusion
of other types of vital records to the system would require only
an additional cost for the software packages for each record type.
Equipment is not required for these additional records since the
disk storage capacity for PC's can be easily expanded at
reasonable cost. Costs for equipment and software would be
required for each site from which the data is entered in order to
implement remote processing. For many states in the United states,
the record volumes are small, in many cases less than 50,000 vital
events annually. In these states, personal computers can
accommodate most of the processing needs associated both with
registration and vital statistics functions.

A second approach being taken is the use of optical disk systems
for record storage, retrieval and issuing copies of records.
Certificates completed in the field are forwarded from the local
registration office to the central agency for coding, scanning,
and indexing for entry into the system. This type of system
produces a high quality image that does not suffer from
deterioration such as found with paper documents. A high
resolution scanner is used to electronically record the documents,
which are stored on optical disks. A computerized index is created
at the time of scanning the records and provides for automatic
searching of the documents. The amount of data entry for the index
is directly related to the number of variables needed for record

identification. Generally these include record number, name, gender, date of the event and place of occurrence.

This system can also provide the capability to enter selected statistical data at the time of preparing the index. This allows for the preparation of basic vital statistics, along with the processing of routine registration activities. In this way, a timely, cost-effective and efficient system for processing registration functions as well as providing a capability for preparing selected vital statistics can be achieved. The number of statistical variables are limited and relate primarily to demographic information for providing descriptive summaries.

Costs associated with optical disk systems vary widely, depending on the size of the system and the applications to be included. The growing use of PC-based optical disk systems makes their use cost effective. Optical disk provides an exact copy of the original document and incorporates the full capabilities of a computerized system to locate, link and process the documents. A major savings in data entry staff, time and resources are also realized with this type of system. Such systems, including scanning equipment, computer and processors can range from $10,000 to $100,000 depending on the size of the application. Use of optical disk in the registration systems in the United States is becoming a major application in replacing early microfilm systems, and for meeting expanding registration needs.

Completely computerized systems for record storage, processing and retrieval in which the registration data are entered and stored on disks on mainframe computer systems are also being implemented in some of the larger states. This approach has a significant data entry cost associated with it, particularly if multiple years of data are to be placed into the system for both registration and statistical purposes. It does however afford the greatest degree of flexibility in terms of total document processing. Copies of the record can be prepared, corrected and mailed electronically; complete indexing parameters are available for record matching and retrieval; updating of data is done without the need to create or modify paper documents; and information is readily available.

## Indexing of Records

A key element in each of the systems described above is the indexing of the stored record. In all cases, automated systems have a computerized index for record search and retrieval, whether the systems are computer-based, optical disk or CAM systems. In most instances, the index may contain sufficient information to produce a legal short-form certification for use by the public. Different methods for indexing are used for locating a record, including a straight alphabetical search on the surname and given name, or other coding algorithms based on the name of the

individual and other selected variables. In addition to the alphabetized or coded name, the date of the event and place of occurrence are usually all that are needed to locate the record. In an index which contains over 5 million records, an average search time for a specific record on a PC is under 10 seconds, depending on the size of the computer and the algorithm used.

The savings in time and staff for processing requests based on a computerized index as compared to manual searching using ledgers or manual microfilm-based indexes are significant. The cost of disk storage has decreased to the point where a computer index on either a mainframe or microcomputer system is a highly cost-effective and efficient method for record searching and retrieval. If an algorithm is used to encode the name of the individual to whom the record relates it must be carefully evaluated and tested. A common name coding system is the Russell Soundex system (Ref. 1). This reduces the number of letters in a person's name, and improves record access in cases where misspellings have occurred. Another algorithm used for this purpose is the New York State Identification system (Ref. 2). Both of these systems are computerized, in which the software automatically produces the codes for each name in the data set.

### *Other Registration Activities*

A number of other registration activities have been developed in the automated system structure. These include transaction processing, billing and accounting features, and direct mailing of both registration materials and information related to maternal and child health. These are labor-intensive activities which are readily adaptable to automated processing methods. Examples of the types of automated activities include:

1. **Record Processing** - data entry into machine-readable format makes the following items more timely and efficient, with minimum staffing requirements:

> * Edits records (replaces former manual edits).
> * Writes letters asking corrections for errors (replaces manual system).
> * Codes entries automatically (replaces manual coding system).
> * Allows on-line update for corrections and amendments (replaces manual coding and batch entry).
> * Allows entry of indexes for historical records.

2. **Correspondence** - automated record and letter forms eliminate need for typing and storage of hardcopy documents.

> * Allows entry of administrative information for all requests for documents (replaces multi-copy paper forms).

* Allows tracking requests in response to inquiries from the public or from law enforcement.

3. **_Fee Tracking and Accounting_** - provides an automated accounting software package to be used for audits, review and calculations.

* Accounts for all fees received (replaces paper documents needed for audit purposes; partial replacement for manual fee deposit requirements).

4. **_Issuance of Certified Copies_** - establishes a standard process for record copy and modifications, with access limited through authorizations to computer files; improves security and confidentiality of the record information.

* Allows immediate search and issuance of birth certificates (replaces manual search and photocopy of record).
* Allows legal amendments to birth records.

5. **_Production of Administrative Reports_** - allows for standard reports and updates in a timely manner.

* Indexes for use by central and local registration offices.
* Fiscal reports for budget, fee deposits, special accounts.
* Administrative workload reports for registration section.
* Reports on field offices.
* Notification of registration of parents.

6. **_"New" Record System_** - provides immediate access to the original record for legal changes or replacement, and for the creation of "new" records where required.

* Preparation of accurate information following adoption or paternity action (replaces manual correction process).
* Update database with "new" information (expedites updating of record data base).
* Cross-reference information for tracking records for the registrant.
* Notification of changes to local offices.

Each of the above automated activities has significantly changed and improved the operation of the states' registration systems in the United States.

## Vital Statistics

Vital statistics activities as noted previously have been automated for many years. The computerization of the data from the registration records have provided the capabilities for preparing national vital statistics reports; for conducting analytical activities related to health outcomes; and, for purposes of

epidemiology and research studies. The major change which has been initiated in the vital statistics area is the electronic transmission of statistical information. Based on the recent movement to automation of civil registration activities, including the implementation of the electronic transfer of registration records, the system has provided for similar transfer of vital statistics.

Compilation of vital statistics has been under a standardized approach, with a close working relationship between the states and the national vital statistics office. There has not been any major new developments in terms of the current available technology. What has been done in this area is the use of more computer software to enhance the reports and analytical functions in preparing vital statistics. Computer software packages for data transmission via electronic media, for analytical studies, and for integration with other health data systems are the primary new technology developments that have occurred in the states' vital statistics systems in the United States.

The major emphasis for applying new technology has been for civil registration activities. This, in turn, has provided more complete, accurate and timely data for preparing vital statistics at both the state and national level. With the new technology applied, the data from the registration system has had a significant impact on improving vital statistics in the United States. The close relationship between these two systems has been maintained as the new technology applications have been implemented, with positive results in both areas. Two specific components to this new development for both civil registration and vital statistics are the development of the electronic birth certificate and the electronic death certificate.

### *Electronic Birth Certificate*

A major area of development at the present time in the civil registration area in many states in the United States is the electronic birth certificate (EBC). Births account for the largest volume of records and require the greatest amount of registration activity. This represents the single most cost-effective record for automation. The amount of information collected on the birth certificate, the number of copies issued annually, the amount of processing for corrections and amendments, and the extent of applications for use of these records far exceed those of all other types of vital records. It is because of these characteristics that the birth record is the first record to be computerized in many states' registration systems.

There are a number of advantages to computerizing the birth record. First and foremost is the fact that the birth certificate is filled out at the site of occurrence of the event. In the

United States, over 95% of births occur in hospitals. This affords a convenient location to place equipment, provide training, and to establish standards for operation of the system. In doing so, immediate benefits are realized including reductions in 1) transcription errors, 2) incomplete reporting of data items which eliminates the need for followback queries, and 3) lost certificates.

Once the data are entered at the hospital, the data are immediately available to the hospital for its own use, as well as in a format for printing and for electronic transmission to the state registration office. A printed paper copy, if needed, may be routed through a series of local agencies prior to final storage at the central office. However, since the data are transmitted electronically there is no delay in the availability of the record. Records can be instantly regenerated either at the hospital or at the central registration office without the need to reenter any of the data.

The security afforded by the electronic system is more effective than in a manual system. Information received only via the electronic system are validated as official records. Fraudulent paper copies of certificates cannot be added to the system since they can be identified through cross-matching of the paper and electronic documents. Entry of data into the records can be done only by authorized staff through a series of controls using identification numbers and passwords for access to the computer system. Any irregularities in the system related to registration data can be quickly identified through staff with authorized access to the computer. All changes to the record are controlled through the electronic system, and can be restricted in terms of what changes are made and by whom.

The EBC affords a number of processing features which reduce the need for subsequent record corrections or changes. The audit/edit features built into the system include spelling checks, data validation, auto-coding of selected variables such as institution and geographic locality through the use of look-up tables, single entry of common data elements such as dates, and automatic calculation of variables such as length of gestation (based on the dates of delivery and last menses) or conversions (eg. pounds and ounces to grams). Each of these features saves significant processing time, reduces the need for subsequent changes to the record, and minimizes many types of errors.

The computerized system provides the flexibility for local access to computer-based birth records. Communication networks can be established whereby an authorized local or regional registration office can access the central computer, initiate a search for a record and have the information transmitted and printed on a birth certification form in the local office. This is a growing area of

development.

The transmission of data to the state central registration office from the hospital for the EBC takes one of several forms. The data, when entered on the microcomputer at the hospital, may be copied to a diskette and mailed to the office. The diskettes are then uploaded on to the agency's mainframe or microprocessors which contain the birth registration database. A second method is to process birth records at the hospital and prepare a database for subsequent transmission electronically over telephone lines. This approach has been implemented in a number of state registration systems in the United States. The EBC being implemented is a computer software product which will result in the standardization of both the recording and reporting of data for birth events. The primary objectives include:

*   Uniform recording and reporting of birth events based on standard data collection and processing procedures.

*   Establishment of a core birth record which can incorporate information by importing the data from other computerized data bases, and exporting data to expand the utilization of the birth information for other applications.

*   Flexibility in record and data modifications; for linkage to other computerized systems; and for record matching.

*   Linking of related maternal and newborn data for medical and health monitoring, and quality of care evaluation.

*   Improve timeliness, data quality and accessibility to the birth information.

*   Provide automated processing functions for registration and statistical purposes.

The electronic birth record has minimized the need for manual intervention in the processing of the record, and has provided significant improvements in 1) the quality of the data as received from the source, 2) the timeliness of receipt of the data, 3) efficiency in processing changes and corrections, 4) maintaining security and confidentiality since fewer staff are necessary to handle the records, 5) availability of the data for multiple use and users, 6) electronic search and retrieval of documents and, 7) minimal physical storage requirements and handling of the documents.

## Electronic Death Certificate

In addition to the transition to the EBC system, states are now moving toward development of the electronic death certificate

(EDC) as well. The ultimate goal of the national committee's agenda is to have both birth and death certificates in the electronic format for processing and transmission by the close of the decade. The EDC is a more difficult record to place in the electronic format from the reporting perspective. In the United States, essentially all live births occur in hospitals which gives a single, common source for the implementation of an electronic birth record. For deaths, approximately half occur in hospitals and the remainder reported from other types of facilities.

The initial efforts being taken at this time is to focus on deaths occurring in hospitals as the primary source for implementing the EDC. Following this, other facilities such as nursing homes and funeral establishments will be incorporated into the electronic system. The percentage of total events reached at this level will then determine to what degree additional reporting sources will be added to the system.

As part of this development for the EDC, the national vital statistics office (NCHS) has developed a software system that allows for the direct computer entry of literal statements for cause of death. The software translates the literal statement into ICD codes, including the underlying cause of death. The software will also edit the reporting of the medical certification items on the death certificate, and will immediately indicate to the certifier if an improper term or sequence of cause events is being entered into the system. The EDC is expected to have a significant impact on the quality of the mortality data and timeliness of reporting of the events.

The goal is to have fifty percent of the death events reported through the electronic network by the end of the decade. This takes advantage of using the hospitals as the initial reporting source. With the EBC in place, implementation of the EDC is essentially the same. Software modifications have been developed and provide for the automated processing of the death records. This includes transfer of the data electronically to the national vital statistics office. Electronic transfer methods for both birth and death record information have been implemented.

**SUMMARY**

The development, application and implementation of automated registration programs have in recent years moved at an accelerated pace in the United States. Impetus for the change can be found in the increased demands of the population for registration services, declining staff resources due to budget cuts, and technological advances which make automation a feasible option. The directions being taken vary and include systems utilizing computers, optical disk and computer-assisted microfilm. Each approach is designed to meet specific needs of the particular registration program.

The direction a particular state registration program has taken is often based on the developments which have been made in other registration programs. Where computerization has occurred, computer programs and systems which have been developed have been made available to other registration programs which are considering implementation of automated systems. It is clear that there is a need for automation as record volumes grow, demands for services increase, and resources and funds decline which are necessary to provide services. Registration activities have not drawn the funding or resources as compared to other programs. This is changing, however, and much of the new efforts are being directed to upgrading programs through the use of automation.

Costs to initiate a computerized system for registration vary widely. Many programs have taken a stepwise approach, automating current registration functions or selected activities and incorporating older records and related processing functions at a later time. This reduces the need for major expenditures for data entry or scanning and indexing of records, computer equipment and software, and training of staff. For registration programs having low volumes of records most of the processes described above can be accommodated on microcomputers.

Other options which permit gradual movement to an automated registration system include microfilm systems utilizing computer-assisted retrieval and optical disk systems. These systems also offer computerized indexing capabilities for record search and retrieval. One of the difficulties associated with these systems is in error correction and updating. Changes to microfilm are difficult, usually requiring the creation of a separate record copy and subsequent storage and indexing of the new record. Current optical disk systems are also in this category, where most have "write once, read many" disk formats, though erasable media are now becoming available. This means that where separate images must be made for corrected or updated records on WORM disks, items can now be deleted and corrections inserted onto the optical disk. The flexibility of the electronic record is clearly superior in this regard. Compared to manual systems, however, both microfilm and optical disk systems offer major advantages.

The question of the capability to transfer components of automated systems from one registration program to another is one area which needs to be explored in more detail. As programs move toward the development of automated registration systems there is a clear benefit to have available the information of what has occurred. Not only are mistakes and problems minimized, but the potential use of software and the processes and procedures which have led to successful operational systems can significantly reduce costs, work efforts and required time period for changes in other programs.

The impact of automation on civil registration programs in general has produced positive immediate results. In the longer term, it provides a basis for standardization of civil registration programs at the national level in decentralized systems. In the United States it also has provided the capability for the electronic interchange of information for registration purposes, vital and health statistics, and technical assistance and support to all participating states.

The capability to share information electronically among states on a national level can be a significant improvement in the monitoring of resident vital events. To develop resident vital statistics at the state level, it is important to know of those events for residents which occurred in other states. Currently in the United States, there is a memorandum of agreement among the states which provides the transfer of vital records occurring in each of the other states to the states in which the individual is of official residence. The complexity of this arrangement has caused some difficulties. Through an electronic system all states are linked to the national program and paper transfers are eliminated.

There is no doubt that in a national decentralized system, where each state is responsible for civil registration but share the data with the national vital statistics office for use in the preparation of national vital statistics and with the other states for obtaining resident vital events, the transition to an electronic system is an effective option. Within each state, the benefits have also been clearly identified. The development of an electronic birth and death record has produced significant benefits for both registration and vital statistics activities.

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