

Computer-Assisted Systems for Forensic Pathology and Forensic Toxicology

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ABSTRACT: A computer software, RättsBASE (RB), was developed for all forensic pathology units in Sweden and introduced in 1992. Simultaneously, a corresponding software, ToxBASE (TB), was developed for the Department of Forensic Toxicology, where all forensic toxicology in Sweden is managed. Both of the databases were created using dBASE IV, and the programming was carried out according to specifications from the staff at the forensic toxicology and forensic pathology units. Since the development of RB and TB was coordinated, the systems can run together smoothly.

The purpose of both systems was to automate the offices and to enable compilation of detailed statistics. Installation of Novell Netware and ISDN-connections (Integrated Service Digital Network) has enabled rapid communication between the units and easy compilation of nationwide statistics of forensic pathology and forensic toxicology.

The systems offer a wide spectrum of reports and include a simple module for evaluation of the importance of the forensic efforts for the whole death investigation. The configuration of the softwares has also enabled processing of a large amount of related toxicological and autopsy data that in turn has yielded a base for compilation of toxicology interpretation lists.

This article includes a summary of the features of the software and a discussion of its benefits and limitations.

KEYWORDS: forensic science, computers, software, forensic pathology, forensic toxicology, database management systems, office automation

The need for effective compilations of administrative and scientific data from the growing material of forensic toxicology and forensic pathology units was the main reason for computerization in Sweden. Such compilations are indispensable for advancing knowledge in our field, for protecting public health, and for detailed reports on the production to the Ministry of Health. Furthermore, the increasing demand for cost-effectiveness of all authorities necessitates automation of office routines.

Computer-assisted systems for forensic pathology and forensic toxicology data are used at different laboratories (own survey, 1-3). Most of these systems offer office automation as well as database processing. There are also commercially available "turnkey" systems that offer these functions (4). Such systems are

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probably the number one choice for offices with limited own computer competence and/or limited time for development of a user-designed system.

The most important benefits of a user-designed program are the possibilities to customize the user-interface including the print-outs, to select variables to be included and their size, and to enable continuous adjustments as demands on the system change.

In 1991, the Swedish forensic pathology units and the forensic toxicology department (as well as forensic psychiatry and forensic serology), formerly independent authorities, were reorganized. The National Board of Forensic Medicine was formed, and thus a need for a coordination and standardization of the administrative information arose.

It was agreed that the data management system for all forensic pathology departments be the same. An integration of the systems for forensic pathology and forensic toxicology was also suggested. Because we realized that the commercially available "turnkey" systems were unable to supply all our specific demands, we decided to construct a system ourselves.

Goals

The development of our systems was managed by the desire to create a software that could support the routine work, i.e., to print out labels, death certificates, toxicology results, and different reports. Furthermore, it should provide rapid adhoc retrieval of cases. Another purpose during the development of RB and TB was to enable statistical processing. Because both systems were developed simultaneously, emphasis was put on functions to make the systems interoperable with specified import and export functions. A third goal was to make the systems accepted as official registers by the Government Archives.

Additionally, we aimed at minimizing fields because large databases slow processing time. Effort should be made to create a simple user interface in combination with comprehensive instructions to achieve a high compliance. Finally, the database programs used should be inexpensive, have abundant programmers, and good support.

Office Environment

In Sweden, with a population of 8.7 million inhabitants, approximately 95,000 deaths are registered each year. The six forensic pathology units, located at 0, 200, 250, 300, and 800 km from the central and only department of forensic toxicology, perform about 5600 autopsies annually. Samples from 4900 of these are tested for alcohol and drugs. In addition, the forensic toxicology department examines approximately 600 driving-under-influence cases, 42,000

samples from prisoners, and 10,000 samples collected from suspected illicit drug abusers.

At present, the national network includes about 80 personal computers (PCs). Each unit is operated by a local area network, supported by Novell 3.11 or 3.12 Netware. The file servers are mainly 486s or Pentium processor-equipped to which 6 to 20 PCs or workstations are connected. All units are connected to each other by ISDN. The number of hard disk and floppy disk drives are kept at a minimum to reduce the risk for unauthorized access to the systems. Tape back-ups are stored in safes, and, for security reasons, exchanged between the units.

The National Board of Forensic Medicine has an agreement with a computer company responsible for both hardware and software support. The dBASE applications were programmed by a professional from that company according to the specifications from the authors.

Description of RättsBASE (RB) for Forensic Pathology

General Description

The software is an application of dBASE IV, and the dBASE language has been used for programming. It is operated by the dBASE runtime files, which occupy approximately 1.7 MB. The program files of the application occupy only 0.6 MB. RB can be run on any IBM-compatible personal computer. However, 2-MB RAM and at least a 386 or higher processor is needed for acceptable performance. Up to nine parameters per file are indexed. During input in RB, data from a limited number of fields are automatically copied to a separate file that serves as an official register for public access.

Almost all fields registered are used for one or several purposes in the day-to-day work. Eight are included only for filling out forms, and are not applicable for statistical processing. An additional three fields are included to provide extra information about examinations other than autopsies. Finally, nine fields are included only for statistical processing and are not of use for routine purposes.

Table 1 shows a summary of the data files of RB, and Table 2 describes the most important fields of the main file.

Mode of Operation

Figure 1 shows the different menus. Input is made in Screens 1 through 3 exclusively. Quick-commands with function keys can be used to jump among these screens. The computer system is integrated in the office procedures as follows:

1. A request from the police is always received before an autopsy. The request includes information about the deceased, such as name, civic registration number, address, previous history (if known), and information about the event, including time and place of death, relevant circumstances and often a preliminary opinion about the plausible manner of death.
2. Data from the police request are registered in Screen 1 of RB. Labels, to put on belongings, or samples collected before the autopsy, may then be printed out. An autopsy planner is offered, and can be printed out. The autopsy planner provides the opportunity to decide which day an autopsy should be performed and offers a printout of the autopsy schedule of each day. From Screen 1, a code form is also usually printed out. This form is filled out by the responsible doctor during

TABLE 1—A summary of different files of RB and TB. A line counter function is included in several files, allowing duplicates of case numbers, and reducing the number of fields. Some fields appear in more than one file (in order to simplify programming).

Program	File	Number of Fields	Field Type	Total Width
RB	Main data file	73	Date 8 Numeric 1 Character 64	1977
RB	9 other files	87	Date 6 Numeric 10 Character 71	1723
TB	Main data file #1	52	Date 6 Character 46	1208
TB	Main data file #2	7	Character 7	91
TB	25 other files	182	Date 22 Numeric 5 Character 155	3429

different phases of the investigation. It serves as currently updated summary of the case and is kept in the file. If the system is down, the most important information about the case is easily retrieved here. A text field is offered for taking down main autopsy findings (character, 50) and a lengthy narrative is included for personal comments.

3. When the autopsy is finished, Screen 2 (see Fig. 2) and connected subscreens are filled out. This input comprises all important autopsy findings, the cause of death, and information about samples collected. The cause of death may be entered in plain language or by entering one of the standard diagnosis codes from which the text is automatically generated. Five different fields for diagnosis codes and corresponding text are available (see also Table 2). Subsequently, a certificate of cause of death, labels for toxicology and histology samples (and any other sample), and an admission note to the forensic toxicology laboratory, are printed out.
4. All new documents, photographs, or other items received are currently registered in Screen 3 and subscreens, as well as the dates when different tasks were performed, e.g., preparation of neck vertebrae, histologic specimens. Likewise, all documents sent from the department are also registered. A subscreen for histology documentation, with automatic summation of the number of specimens, is filled out. A character field is provided for documentation of different histologic stains. Another character field is reserved for information from the pathologist to the laboratory technicians. A document comprising the histology data and all other information about the case, relevant to the technical staff, may also be printed out.
5. When the case is completed, and the final autopsy report is sent to the police, the date of completion is noted. The case is then automatically given restricted access to secure originality.
6. At regular intervals, all fields corresponding to the certificate of cause of death are exported to a file that is sent from each unit on floppy disks to the National Bureau of Statistics.

TABLE 2—The most important fields of the main file of RB.

Variables

Case number (two different)
 Civic registration number [1]
 Name of decedent
 Address of decedent (two fields)
 Police dept (two fields)
 Date of examination
 Time of examination [2]
 Date of arrival of police request
 Police investigation number
 Preliminary notes
 Case history
 Requested type of examination
 Performed type of examination [3]
 Place of examination
 Date of death (three different) [4]
 Place of death (address, zip code)
 Place of death (hospital, home etc.)
 Responsible pathologist
 Immediate cause of death [5]
 Underlying cause of death 1
 Underlying cause of death 2
 Contributory cause of death 1
 Contributory cause of death 2
 Cause of death uncertain (five fields) [6]
 E-code [7]
 Another person responsible for death [8]
 Manner of death
 Operation within 4 weeks prior to death
 Cause of operation
 Date of operation
 Pacemaker present
 Description of injuries/poisoning [9]
 Photography performed
 Research project [10]
 Autopsy findings in brief
 Drugs prescribed or found
 State of the body (decomposition, three degrees)
 Toxicology priority
 Other information to toxicology dept
 Messages to histology lab. technicians
 Date of completion

Comments:

- [1] Age and sex of decedent are derived from the civic registration number.
- [2] The date and time for examination may be planned in advance for non-urgent cases in order to make work load more even. The autopsy planner, which resembles a commercial electronic booking calendar, is then used.
- [3] The type of examination is partly dependent of the manner of death, thus it may be changed due to autopsy findings.
- [4] Date 1: Last seen. Date 2: Found dead. Date 3: Instead of Date 1 when date is invalid (character field).
- [5] Diagnoses according to WHO instructions. Each of these fields are connected to a field containing the corresponding ICD-9 code.
- [6] For each diagnosis a high degree of uncertainty may be stressed here.
- [7] This ICD-code is based on the description of how injury or poisoning occurred. If more than one unnatural event preceeded death, the E-code depends on the highest ranked diagnosis.
- [8] This field is essential for retrieval of all deaths caused by another person, apart from classic homicides.
- [9] Character field including description of how, when and where injuries or poisoning occurred.

To retrieve information about a certain case, a rapid search using the name, civic registration number, case number, or date of examination can be performed using the function keys. Screen 3 displays all input. A memo screen is also available from this screen. The memo window allows for lengthier notes to be made as well as for quick import of autopsy protocol. Searches can be

made on most variables, but not as rapid if nonindexed variables are chosen.

Standard Reports

The staff of the forensic pathology units were asked to suggest special reports apart from those necessary for the daily operation.

TABLE 3—The most important fields of the two main files of TB.

Variables

Main file #1

Case number
 Clients case number (from forensic pathology)
 Name of deceased
 Civic registration number
 Date of autopsy
 Performed type of examination
 Date of arrival of request and samples
 Preliminary notes
 Drugs prescribed or found
 Toxicology priority
 Samples received (ten fields)
 Requested analysis (ten fields)
 Responsible pathologist
 Responsible chemist
 Date of completion
 Date of request of supplementary analysis
 Date of completion of supplementary analysis
 Comments on the case (two fields)
 Comments on analytical results (four fields)

Main file #2

Case number
 Name of substance found
 concentration found for each substance
 types of samples
 analytical method used

Comments:

Some of the fields are imported from RB.
 The main file #2 includes a line counter function.

Thus, a limited number of standard reports for routine statistics have been included in RB:

- (1) number of cases distributed to police departments and type of examination or distributed to responsible pathologist and type of examination (cross tabulation),
- (2) lists of all cases examined/all completed/all pending cases (case by case),
- (3) investigation time interval (number and percent of cases completed within 1, 2, 3, 4, and 5 weeks after examination)⁴ (cross-tabulation),
- (4) list of certain diagnoses (cause of death and/or E codes), or groups of diagnoses⁵ (case by case),
- (5) diagnoses and/or E codes distributed according to police departments (cross tabulation),

⁴The figures refer to the final report including all supplementary investigations, such as toxicology, bacteriology, and microscopy. In many cases a written preliminary report is sent to the police immediately after the examination. The numbers are given for each type of examination.

⁵A diagnosis (or a group of diagnoses) can be retrieved by the corresponding ICD-9 code, regardless of its position on the certificate of cause of death. The fields containing diagnoses are described in Table 2. The same principles apply to the E-codes, e.g., E95 yields all suicides.

RättsBASE

Ver. 950215

1. Registration
2. Autopsy results
3. Additional data
4. Print-outs
5. Export/Import
6. Statistics/Search
- A. Clerical register
8. System management
9. Exit

<p style="text-align: center;">Print-outs</p> <div style="border: 1px solid black; padding: 5px;"> <ol style="list-style-type: none"> 1. Code form 2. Certificate of death 3. Certificate of cause of death 4. Toxicology admission note/labels 5. Histology report 6. Examination planner 0. Main menu </div>	<p style="text-align: center;">Export/Import</p> <div style="border: 1px solid black; padding: 5px;"> <ol style="list-style-type: none"> 1. Toxicology admission note 2. Diagnosis codes 3. Import Toxicology result 4. Statistics brief 5. Statistics full 6. Certificate of cause of death 0. Main menu </div>
<p style="text-align: center;">Statistics/Search</p> <div style="border: 1px solid black; padding: 5px;"> <ol style="list-style-type: none"> 1. Cases by police dept 2. List all cases 3. Control list 4. Investigation time span 5. Diagnoses 6. Diagnoses by police dept 7. Missing values 8. Explore toxicology data 0. Main menu </div>	<p style="text-align: center;">System management</p> <div style="border: 1px solid black; padding: 5px;"> <ol style="list-style-type: none"> 1. Pack/Index registers 2. Change parameters 3. Change year 4. Create new register 5. Update 6. Check empty case 0. Main menu </div>

FIG. 1—The different menus of RB. Explanations are given in the text.

SCREEN 2

Quick #	B		
Case ID		Civic reg #	0
Autopsy date		Name	
Autopsy code		Address	
Age code		Zij code	
Other person		Death date 1	2 . . . 3
Hospital			
Place of death			
Pathologist			Prel. certificate
Code	Text		
1a			
1b			
1c			
2a			
2b			
Op	Op-date	Op-cause	
Manner of death		Face-maker	
Description			
Varia			
Findings			Suppl. certificate

Bnr F2=Register F3=Change F4=Search F5=print-out F8=Toxicology F9=Clerical

FIG. 2—Screen 2 of RB. The function keys will bring up pop-up menus and subscreens. To avoid changing of data by mistake, or by unauthorized persons, an access code must have been entered before using the function keys. In some fields (e.g., "Pathologist" and "Code") entering a standard code will bring up a text from a reference file. Quick # is a automatically generated number, specific to each case at the local unit. Case ID is not entered until the examination is performed, because the police sometimes cancel a death investigation that otherwise would cause annoying blank records. The syntax of the case ID is, e.g., D95-1092, indicating the forensic pathology unit in Lund (=D), year 1995, number 1092. This facilitates sorting and searching. Autopsy code refers to the kind of autopsy performed. Other person (Yes/No?) refers to whether death was caused by other person or not, regardless of intention.

- (6) lists of cases with positive analysis of a certain substance (optionally in combination with a certain diagnosis or E code) (case by case).

We were anxious not to put too many seldom-used functions (e.g., complex searches and reports based on many fields) into the software, because this makes it slow down, requires more indexes, and makes the maintenance of the software more complicated. Instead, we included two export options, which may be used by those who wish to produce their own reports and compilations. All fields or a limited number of fields may be exported to a .dbf file that can be customized using ten different fields for selection. The processing of the data of this handy .dbf file may then be done using any software capable of importing .dbf files. An option for making records nonidentifiable is offered if the data are to be used by researchers outside the organization.

Special Features

Data Validity Checks

The civic registration number must be valid. The calculation is identical to that used by all Swedish authorities.

Invalid dates are rejected. The date of birth, the date of death and autopsy date are checked.

The police departments are stored by their official numeric codes, but their complete or partial names can alternatively be entered. The program then suggests a choice that can be confirmed or rejected. The same principles are used concerning the pathologist's name and code. This prevents misspelling errors that otherwise could cause problems during data retrieval and statistical processing.

In a reference file, 141 diagnosis codes, based on ICD-9, with automatic generation of plain language (which accounts for approximately 96% of diagnoses used), are stored. The text is a modification of the ICD-9 format enabling the doctors, the National Bureau of Statistics, and common people (relatives, the police, and jurors who read the certificates of cause of death) to understand.

A warning is displayed when data in certain fields are incompatible with data entered in other fields. For example, an E code and a FRT code (Feedback of RättsBASE and ToxBASE, see below) must be consistent with the previously entered manner-of-death-choice.

A case cannot be completed if certain fields are empty (e.g., cause-of-death-diagnoses, E code, or FRT).

A checklist of incompatible data is provided. This procedure displays all cases in which the information in the following variables seems to be incompatible: death caused by another person, manner of death, diagnosis codes, E code, and FRT. Separate lists are printed out for each of the responsible forensic pathologists.

Another checklist provides missing data: the address of the deceased, police department, responsible doctor, and date of examination.

FRT (Feedback of RättsBASE and ToxBASE)

An additional feature of the software is the registration of a preliminary and a final code for the manner of death. The preliminary code is based upon the request from the police, and, on additional information obtained before the autopsy is performed; the final code is based on the findings at the completion of the case. The coding system is a convenient way of estimating the importance of the forensic pathology and toxicology efforts. Thus,

from these data it was found that in 1994, about 10% of the homicides in Sweden were not primarily recognized by the police. FRT processing also revealed that the opinion about the manner of death was changed in 28% of the cases. These data are not completely accurate because the police are not actually interviewed, but they offer a fairly good estimate of the contribution of forensic efforts to the whole death investigation.

In autopsy cases in which the forensic results indicate that another person may be responsible for the death (e.g., homicides and traffic accidents) a questionnaire is sent to the police (Fig. 3) that enables an estimation of the number of cases that end up in court.

In every clinical examination, the forensic pathologist enters an E-code according to the description of the event given by the police, and another two codes related to the results of the examination. The first code offers six alternatives: injuries found or not found + result confirms or contradicts the story as described in the police report, or result inconclusive. The opinion of whether or not the injuries were lifethreatening constitutes the second code. This construction enables retrieval of cases even if the examination was negative (e.g., in many sexual abuse cases). The police questionnaire is also used for the clinical examinations.

Description TB (Forensic Toxicology)

General Description

TB is also a dBASE application, and operated in the runtime mode. The program files occupy approximately 0.6 MB. A summary of the data files of TB is shown in Table 1, and the most important fields of the two main files are shown in Table 3. In addition to the forensic pathology cases, TB also includes data from drugged driver cases and drug analyses of samples from suspected drug abusers.

Mode of Operation

The menus of TB are shown in Fig. 4. New cases are registered in Screen 1. This can be done in two ways. Normally, a floppy disk is received from the forensic pathology unit along with the admission notes and the samples. The information on the floppy disk is identical to that of the admission note. The data can thus easily be imported to the system. Alternatively, when a floppy disk is lacking, the information can be entered manually.

Screen 1 also offers several other functions, such as retrieval

- | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> o Police investigation closed - form returned o Case reported to district attorney/prosecutor - form sent to prosecutor o Case dismissed by prosecutor - form returned o Defendant prosecuted - form sent to court o Verdict of guilty - form returned o Verdict of not guilty - form returned |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

FIG. 3—Feedback form sent to the police in autopsy cases in which the death was caused by other person. Each alternative is registered (three fields). This registration enables a rapid retrieval of cases, in which the police investigation was closed, or the prosecutor dismissed the case. Then the responsible doctor can look at the autopsy report and his conclusions, and thus make reflections as to whether the death investigation could have been improved, or if the word choices and phrasing in the conclusion might have been misleading.

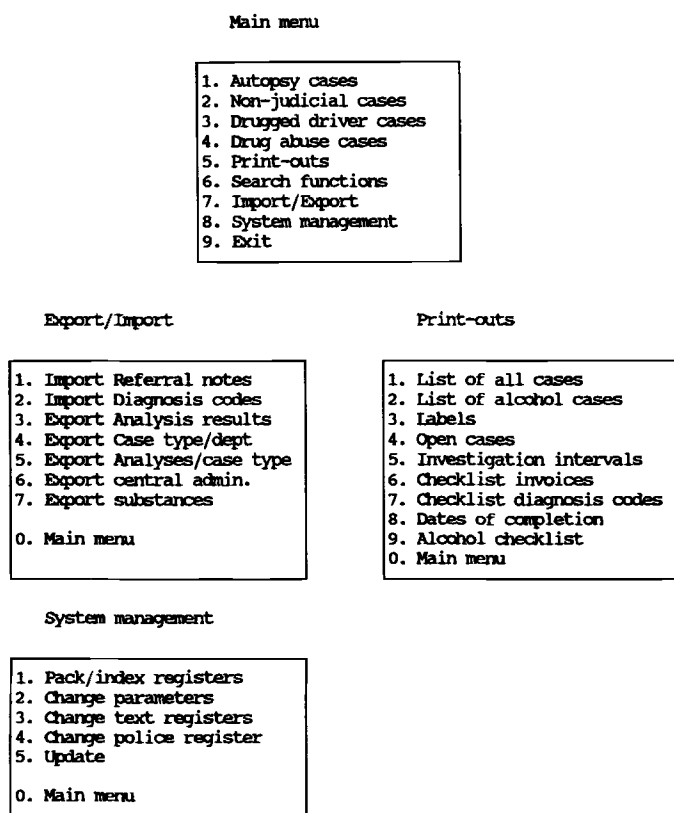


FIG. 4—The different menus of TB. Explanation are given in the text.

of cases by name, civic registration number, and autopsy case number, a text editor for longer notes about the case, and different types of reports, that can be printed out. Thus, all functions needed for the autopsy cases are included in this screen and related subscreens.

Standard Reports

For routine purposes, the system has been designed to produce the following items:

- (1) A list of all cases, showing case number, date of arrival, principal and analytical request,
- (2) Laboratory list for ethanol analysis (planner),
- (3) Labels for internal marking of workpapers and samples,
- (4) Pending case list,
- (5) Investigation time interval,
- (6) Lists for data validity checks, and
- (7) A procedure for adding date of completion.

Special Features

When cases are completed at the forensic pathology unit, all diagnosis codes and E-codes are transferred from RB to TB. Conversely, the toxicological results are transferred from TB to RB via ISDN.

During input in TB, data from a limited number of fields are automatically copied to a separate file, which serves as an official register that is accepted by the Government Archives.

A search option that selects all cases ever found positive for a certain drug is available. The case number, the age of the victim,

the concentration of the drug, the sample type, and the ICD-diagnosis codes are shown on the screen or printed out.

A search option, based on the civic registration number, is also available. This procedure checks all files for matching records. A person may thus be found twice in the register of drugged drivers, twice in the register of samples from suspect drug abusers, and four times in the register of drunken drivers. This option can reveal interesting patterns particularly if the drugs involved are studied.

An additional procedure provides a compilation of all combinations of substances, and the number is given for each combination.

Every substance that has been found at the department of forensic toxicology has been given a specific code. In a reference file, the specific code and the generic name of the substance are stored along with supplemental information about the drug. This information includes data about therapeutic concentrations; in which drugs the substance can be found; its anatomical therapeutic classification system (ATC code); if the substance is regarded as dangerous to drivers; and, if relevant, narcotic classification. In drugged driver cases and suspected drug abuse cases, this general information is printed out automatically along with the test result.

In addition to the information in the referral notes from the forensic pathology units, the diagnoses of the deceased are imported by their ICD codes. Thus, the cases may be classified as intoxications, uncertain cases, and cases in which the cause of death by certainty was not an intoxication (e.g., hangings and shootings). Although a manual judgment of each case is necessary, the automated rough selection of cases according to the degree of free activity immediately before death is an indispensable tool when exploring large amounts of data. This classification function has enabled listing of drug concentrations of both intoxications and "control" cases. The latter are probably more relevant to the forensic pathologist than information of therapeutic concentrations when interpreting toxicological data.

Discussion

Although it is desirable that biomedical databases should be standardized in order to be interoperable, there are ways to overcome problems due to the lack of standardization (5). In fact, our electronic transfer of death certificates to the National Bureau of Statistics that uses a Paradox application is a practical example. Therefore, we believe that any system that supports conversion of files to ASCII or similar widely used format is acceptable. We decided to develop our system on dBASE because it is inexpensive, widely used, and there are abundant competent programmers and good support.

The overall goals of a certain system must be thoroughly considered. For optimal performance, a good deal of planning is needed before a system is implemented. It is worth mentioning that suggested objectives of systems for intensive care units (6) are similar to those proposed for medical examiners and coroners (7). In our experience, the most difficult decisions concern the inclusion or exclusion of certain variables. It is tempting to include as many variables as possible, but this will increase the size of the files and may reduce the program performance speed. Besides, the reliability of data of variables considered less important by the users can be questioned because input may be inaccurate.

The registration of histology data has been worthwhile for day-to-day work as well as for statistical use. Information is easily accessible for everyone involved in the case, and messages from the pathologist to the laboratory technicians can be sent via the

histology screen. Besides, for educational purposes, it is advantageous to be able to quickly locate specimens from a certain organ where a special stain has been used.

In order to reduce negative effects on day-to-day work, the staff at all units were informed about the planned changes and were given opportunities to make comments and suggestions before the systems were introduced. In the first versions, only the most important functions were included. Gradually, more functions were added in small steps to ensure good user compliance. This strategy is suggested by Hanzlick (7), and our experiences have invariably been positive.

The office automation has provided opportunities for the staff to concentrate on quality assurance programs and has released time for research projects. The use of the variables included both for office automation and for statistical processing provides a manual control of data; all information printed out on the death certificates and the toxicology reports that are to be checked and signed by the responsible doctor are identical to those stored in the system and used for data processing. Both systems offer a number of data validity checks. Such features have been pointed out by Hanzlick (8), and the similarities with those included in our systems are striking.

The multiple uses of most of the variables are an advantage over systems in which the intention is only statistical. Such a system was developed in 1985 and used by the forensic pathology units in Sweden for some years. However, although the software was right to the point with a simple interface, system usage failed at some departments because the immediate value of the system for the individual user was limited. Apart from the good compliance of RB, the information recorded is checked when the doctor signs the death certificate, admission note to the forensic toxicology laboratory, etc. Finally, control functions are built in that prevent the user from entering invalid data, and control lists are run regularly to check that data in linked fields are compatible.

The usefulness of forensic pathology and forensic toxicology information for occupational risk surveillance, pharmacovigilance, traffic safety, and similar public interests, in addition to pure forensic use, has been stressed by different authors (8–10). Thus, it is important that the data gathered maintain a good standard as to accuracy and quality. These points have been thoroughly considered by Hanzlick (7,8). However, our experience is that during implementation of a new system, hindrance caused by a number of control functions will make some users frustrated, and a lot of time must be spent on explaining to users why certain checks are included. This is particularly true if the system is to be used by many employees and at separate units. Therefore, we decided to introduce data validity checks and other control functions stepwise.

Printouts of invalid data and inconsistencies are provided, and retrospective correction of input has not been overwhelming for the pathologists or the chemists because most input is actually checked manually when certain printouts (e.g., death certificates and toxicology reports) are signed.

The most valuable effect of the simultaneous development of RB and TB concerns the integration of pathology and toxicology data. This enables listing of pharmaceutical drug concentrations in which the cause of death and other relevant variables are used for classification of cases. We suggest this method be used by other offices for improved quality of toxicology interpretation.

The integration of forensic pathology and toxicology data also facilitates the access of all relevant case information for the responsible pathologist and chemist, respectively.

An agreement has been made with the National Bureau of Statistics about submitting the certificates of death on floppy disks. Thus, such an export option is provided in the program, and will probably expedite the annual report of the nationwide death statistics. However, a hard copy of the death certificates will still have to be issued because of regulations.

A time-saving function for all units is the automatic production of a file accepted as an official register. This feature also saves a good deal of paper.

Although we are quite satisfied with both systems as far as performance, simplicity, and overall functions are concerned, the softwares are currently being rewritten in C++ to be prepared for future events. A disadvantage of using dBASE for DOS is the lack of graphic options. We have solved this problem by providing different export functions. Those who feel that frequent routine production of graphs from the database material is essential should select a database program other than dBASE. A natural step in the development of our systems would be to use dBASE for Windows, but we are unwilling to let our systems be restricted to only one database program.

One pitfall shared by many database programs is the reduced performance speed when files become too big. In our system, a number of the files have therefore been split. We recommend that this problem be considered in the early phase of system development, although it may be hard to prognosticate the size of certain files, especially when open-ended memo fields are included.

In summary, RB and TB were designed to serve both routine purposes and statistical processing. We suggest that such a strategy be used when implementing systems elsewhere. Also, we would like to encourage integration of toxicological and autopsy data to provide all relevant information to both pathologists and chemists.

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