An on-line computer system for histopathology reporting

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SUMMARY An on-line computer system was developed for issuing histopathology reports as part of an integrated hospital information system. Input is through a Cossor visual display unit with a typewriter keyboard to a Univac 418 III computer. Stored information is available to authorised hospital staff via similar visual display units located in the wards and laboratories. Existing programs and computer staff were used to provide the new service. It has resulted in better methods, speedier communication, and saving of laboratory staff time. The system has yet to be fully tested but initial reactions are favourable and indicate that the investment in computer staff time and extra laboratory equipment will be cost effective.

In 1966 the Nuffield Provincial Hospital Trust sponsored the introduction of computer facilities to the Queen Elizabeth Hospital, Birmingham, to deal with inpatient registration, laboratory management, and specimen reporting. Other systems were introduced later, and in 1968 the hospital was asked to participate in the Department of Health and Social Security's experimental computer programme. Univac and Cossor equipment able to handle 'live' information was installed in 1972. A visual display unit (VDU) was chosen as the means of 'on-line' communication with the computer and departmental systems were designed to feed data to the VDU for use by ward staff. Systems for patient administration and for the reports from the departments of bacteriology, clinical chemistry, and pathology (histopathology) are now fully operational.

Development of system for histopathology

The existing on-line system used for bacteriology reports included a method of issuing free text reports of limited length and it seemed that the same method, suitably modified, could be used for histopathology reports. An experimental transmission confirmed that all the necessary information could be included—identification of the patient, his location within the hospital, laboratory number, the nature of the specimen, and finally a coded description of the specimen and diagnosis for use in the

Birmingham Histopathology Data Pool (Codling *et al.*, 1977). Important modifications to the bacteriology system included the addition of extra screens of information to transmit a complete histopathology report. Furthermore, a check system was required to ensure that only complete reports consisting of both macroscopic and microscopic findings were displayed on the VDU.

Six man-months of working time by the computer department would be needed over a period of about a year to achieve these modifications, whereas a system specifically designed for histopathology would have taken at least two to three years to develop and would have had a lower priority than projects currently under development. It therefore seemed sensible to proceed on the basis of modifying existing programmes. An on-line reporting system required only the modest addition to the existing computer facilities of one VDU and about 100 metres of cable.

Operation of system

When the new system was introduced the flow of work through the laboratory and the technical methods in use were unaffected. The major impact was on the clerical and secretarial procedures. The secretaries, pathologists, and technicians had to be trained in the use of a VDU. In the case of technicians and pathologists this was simple and required less than one hour's training per person. The change in the work pattern of the secretaries was more complex. They were responsible for arranging the

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HISTOLOGY: THE PROSTATE SHOWS THE FEATURES OF
FIBROMYOEPITHELIAL HYPERPLASIA WITH
.....MICROCYST FORMATION, AREAS OF CHRONIC
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.....THERE IS NO EVIDENCE OF MALIGNANCY....

.....J. C. MACARTNEY

DIAGNOSIS: HYPERPLASIA OF PROSTATE.....

.....4005,B,C, , , , ,7700,7300,0000,0000,**

CONS,S,P,USER,I,F,G,P,T ,M ,E ,F ,**

NR

Press reset and enter current lab No

Then enter next lab No to input results for another specimen

Fig. 3 Results entry screen for histological findings with same format as for macroscopic findings (see Fig. 2). Last line contains information for Birmingham Histopathology Data Pool.

the secretary in exactly the same way as the macroscopic descriptions and under the same laboratory number. When continuation pages are required the request entry sequence is used to enter a fictitious laboratory number which is associated with the correct patient and genuine laboratory number. Any number of continuation pages can be obtained in this way. The typed report ends with the name of the pathologist, the pathological diagnosis, and a line of coded information (SNOP line) which includes the Systematised Nomenclature of Pathology (SNOP) code number for use in the Histopathology Data Pool.

CHECKING, ACCEPTANCE, AND DISPLAY

Screens of information entered by the secretary can be checked and accepted as accurate only by a pathologist. The reports are usually checked in two stages—firstly, after entry of the macroscopic findings into the system and, secondly, after completion of the histological findings. In checking macroscopic descriptions the pathologist may select either the first unchecked report screen or, by typing the laboratory number in the space allocated, a specific report screen. If the information on the screen is correct it is accepted as accurate and sent to a holding file but not made available to the wards unless it is the final screen completing a report

(see below). The pathologist then automatically receives the next screen for checking. This procedure is repeated until all available screens have been checked. The secretary is informed of errors and she rejects the report screen concerned and corrects the errors. When the final screen of a report is encountered a marker (D, or display marker) has to be used to instruct the computer to make the entire report available for display to authorised personnel on the VDUs throughout the hospital. Requests from patients not registered in the hospital information system as well as reports on biopsies from members of staff are excluded from the system.

At the end of the working day the computer prints all completed and displayable reports (Fig. 4). These are sent to the wards for insertion into the patient's notes for future reference. Copies of reports are also sent to the laboratory for keeping in numerical and disease index files for long-term storage and use.

EFFECTS OF INTRODUCING THE SYSTEM

The introduction of the system less than one year after the original concept was developed was uneventful and was well received by the staff. No problems have arisen over confidentiality or in obtaining information from the system, probably because most of the staff were already familiar with the use of the VDUs and possess unique personal log-in codes which allow only authorised users access to patient information.

Discussion

BENEFITS OF SYSTEM

We have reported elsewhere (Codling *et al.*, 1977)

Patient's Name	Registration No.	Sex	Age	Admission Date	Ward	Consultant Prof
SMITH John	G123456/7	M	21	01.01.77	W1	Ashton
BIOPSY						LAB NO. 00001/x
COLLECTION DATE 07.02.77						
NATURE OF SPECIMEN: PROSTATE						
MACROSCOPIC: FIVE FRAGMENTS OF PROSTATIC TISSUE, TOGETHER 74 GRAMS, WITH A NODULAR APPEARANCE EXTERNALLY AND ON SECTION, MICROCYST FORMATION IS ALSO EVIDENT.						
HISTOLOGY: THE PROSTATE SHOWS THE FEATURES OF FIBROMYOEPITHELIAL HYPERPLASIA WITH MICROCYST FORMATION, AREAS OF CHRONIC PROSTIATTIS AND CORPORA AMYLACEA FORMATION.						
THERE IS NO EVIDENCE OF MALIGNANCY.						
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4005,B,C, , , , ,7700,7300,0000,0000,**						

Fig. 4 Printed version of report.

that 27% of request forms were found to contain errors in patient identity. These have been eliminated by the computer system, which detects errors and ensures their correction before the specimen can be reported on. Furthermore, the availability of the report throughout the hospital and delivery of the typewritten version to the ward where the patient is at the time of issue ensures that it is available to authorised individuals at all times. A reprint of a report can be requested directly from the computer.

Under the previous system reports were sorted and delivered by hand to the ward between 5 pm and 6 pm usually on the day after receipt of the specimen. Action based on the report generally had to be delayed until the next day. With the on-line system the histopathology reports are available on the ward up to six hours earlier than previously, so that action can often be taken the same afternoon. Definitive treatment may be instituted quicker or patients discharged earlier—for example, a patient with a benign breast lesion—leading indirectly to improved bed occupancy.

Allocation of laboratory numbers is simplified and more accurate, since those used by the computer contain check digits which allow the detection of transcription errors, and the use of the same number for more than one specimen is prevented. Previously the reports had to be sorted at the end of the working day and delivered to the wards, where they were signed for. This no longer happens, saving about one technician hour per day. The number of telephoned queries from the wards about individual specimens has also fallen considerably.

The use of an on-line system simplified secretarial procedures within the laboratory. Indexing of cases is automatic and the sorting and filing of reports at the end of the day is reduced to filing copies of the typed reports received from the computer. The typing procedures are simple and a major advantage is that reports can be entered into the system right up to the end of the working day. Previously the typing of reports had to finish before 5 pm. Now reports that would have been delayed for a further 24 hours can be issued. Secretaries find that most of their work is complete by 4.30 pm and they can use the rest of the day for other tasks. The new system therefore allows for a more flexible work schedule.

The on-line system has several advantages for the pathologists. Results on tests carried out by the departments of clinical chemistry, bacteriology, and haematology are instantly available and there are fewer inquiries about the progress of a specimen through the laboratory. One major disadvantage is the need for the pathologist to check and accept reports for issuing to the wards twice daily, whereas previously he signed his reports at 4 pm.

Instead of searching for typed reports in the patient's notes the ward staff can obtain information immediately on the VDU. Moreover, they can find out about the progress of a specimen without telephoning the laboratory. Should a typed report be missing from the notes the information can be retrieved immediately from the VDU. Furthermore, since it is the department's custom for safety reasons not to give reports over the telephone, other than on urgent frozen sections, the ward staff do not have to wait until the copy of the original report has been typed and sent to the ward.

Minor problems that have arisen have been readily overcome. However, should a serious breakdown occur on a busy day the laboratory would resort to issuing typewritten reports. That would not be disastrous but the secretary would have to be informed in time in order to revert to typewritten reports. The hospital staff have welcomed the new system. Pathologists have not found checking reports on the visual display unit unduly burdensome but a second VDU in the reporting room would be more convenient and would save time.

EVALUATION

Before the new system was introduced the computer evaluation team of the Queen Elizabeth Medical Centre carried out a systems analysis of the laboratory together with an assessment of the previous system of reporting. It showed that in cases of breast tumour the receipt of a benign histopathology report influenced the time of discharge of the patient in a significant proportion of cases.

A similar study is to be carried out on the new system. It was predicted in the first report that there would be a potential saving of 99 patient days per annum if reports on breast biopsies were received earlier. This is now possible with on-line reporting. This potential maximum saving with on-line reporting has yet to be confirmed, but if it is, its extrapolation to other areas of clinical decision making might well represent a significant increase in bed occupancy and turnover.

FUTURE DEVELOPMENTS

Four possible developments are envisaged.

(1) Automatic SNOP coding of reports by the computer at the time of report entry would be useful since there could then be a uniform standard of coding. This would make searches of stored SNOP data more precise and free the pathologist from the task of manual coding.

(2) It may be possible to develop an on-line quality assurance system in histopathology. For example, multidimensional analysis of stored SNOP data on skin tumours (Henson *et al.*, 1977) could

be carried out using site, age, sex, etc, as variables. Individual cases could then be compared with these reference data at the time of on-line reporting and be brought to the attention of the reporting pathologist if outside the main cluster of cases.

(3) Full or abbreviated necropsy reports could be made available shortly after the examination.

(4) Cytology reporting could easily be accommodated in the system.

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