The Birmingham Histopathology Data Pool: a co-operative project among 10 laboratories

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SUMMARY In 1970 the Birmingham Histopathology Data Pool was established to collect information on biopsies of surgical specimens from three hospitals. The scheme has gradually expanded and 10 hospitals now participate. The pathologist gives each specimen a numerical code based on the Systematised Nomenclature of Pathology (SNOP). The information is processed by computer and stored on cumulative magnetic tape file. At regular intervals (at three, six, and nine months) 'print-outs' listing all the information recorded within the interval are produced and a cumulative print-out is issued when the information for a whole year is complete.

The data pool system has provided accurate alphabetical and SNOP diagnostic files and has simplified retrieval of data for both follow-up and research purposes. The pathologist may use the computer to retrieve and analyse information from the data pool for his own use or on behalf of clinicians, but he may use information from laboratories other than his own for research purposes and publication only with the permission of the pathologists who submitted the data.

The value of computer techniques for handling the large volumes of data generated in clinical chemistry, haematology, and bacteriology laboratories is well established (Whitby and Blair, 1970; Whitehead, 1970; Farrar *et al.*, 1975). Similar techniques (Pratt and Thomas, 1966) have not been adopted widely by histopathology laboratories for two main reasons: (1) their output consists of verbal reports on the macroscopic and histological features of tissue specimens leading to conclusions or diagnoses which are the opinions of the pathologist; (2) the number of specimens handled is relatively small.

Of the several systems available for codifying histological lesions the Systematised Nomenclature of Pathology (SNOP) (College of American Pathologists, 1965) is that most widely used by histopathologists. Moreover, when the information from several laboratories is pooled the number of specimens increases greatly and the advantages of computer-based methods are obvious. Another advantage is that histopathological records are usually kept indefinitely, not only as a potential source of research material but because they contain information which may at some future date have a bearing on the diagnosis and treatment of individual patients. For these reasons we chose a computer-based

system when we decided in 1970 to establish a histopathology data pool which would store codified diagnoses from a number of centres.

Initially data were collected from three laboratories—those serving the Queen Elizabeth Hospital, Birmingham, the East Birmingham Hospital, and the South Warwickshire Group of hospitals.¹ In 1975, 45 313 diagnoses were recorded (Table 1) from report forms (Fig. 1).

Methods

COMPUTER FACILITIES

Until November 1976 the data pool was based on the IBM 1440 computer at the University Medical School, which has a 16K character core size. In addition to the computer the facilities included an IBM 1442 card reader and punch, an IBM 1443 line printer, two 7335 magnetic tape drives, and

¹Other hospitals now in the data pool are the General Hospital, Birmingham (1973); the North Staffordshire Hospital Centre, Stoke; Good Hope District General Hospital, Sutton Coldfield; Birmingham Dental Hospital; the Midland Centre for Neurosurgery and Neurology, Smethwick; Staffordshire General Infirmary (1975); and Walsall Hospital (1976).

Table 1 Number of diagnoses recorded in the histopathology data pool since its inception in 1970

Year	No. of participant hospitals	No. of diagnoses	No. of diagnoses per month
1970/1	3	16 273	1084
1972	3	15 417	1285
1973	4	22 084	1840
1974	4	24 089	2007
1975	8	45 313	3776

two 1311 exchangeable disk drives each with a nominal capacity of 2 000 000 characters. Data were stored on magnetic tape (maximum size 2400 ft (730 m)) with a density of 556 bytes/in (2.5 cm) and an inter-record gap of 0.75 in (19.1 mm). This density gives about 32 000 records per tape. In November 1976 the data pool was transferred to a Univac 418 III computer which has a much greater handling capacity.

INPUT OF DATA

Standard 80-character punch cards are used (Fig. 2) to record details of patient identity, specimen identity, and the pathological diagnosis, coded according to SNOP, transferred either from the report form or a listing in suitable order. Columns 1-3 of the card identify the hospital; columns 4-28 identify the patient by registration number, sex, ward, surname, forenames, and year of birth; and the specimen is identified in columns 29-39 by its date of arrival and its laboratory number.

The consultant in clinical charge of the patient is indicated (columns 40-43) by a four-digit number derived from the West Midlands Regional Health Authority's specialty and consultant code list. The type of preparation (column 44)—that is, frozen section, paraffin section, smear, and origin at either biopsy or necropsy—is indicated by a single letter code.

The pathologist code (column 45) is also a single-letter code indicating the pathologist responsible for

the report. The final 16 columns of the computer card contain the SNOP code.

Although the histopathology report forms are designed to suit the individual needs of each laboratory taking part, the information required by the data pool is in the same order on each report form (Fig. 1). This facilitates the process of card punching, which is carried out centrally in the data preparation unit of the Queen Elizabeth Medical Centre Computer Services Unit.

PROCESSING

After the cards have been punched they are checked for accuracy (that is, verified) by the card punch operators and submitted to the computer. Data are checked for accuracy within defined limits (that is, validated) by the computer (see below) and then transferred to magnetic tape files by means of programs written in Autocoder and an IBM sort utility program. The validation criteria are simple in that omissions are not allowed in fields other than the description field. Alphabetical and numerical characters must appear in the appropriate columns. To cater for patients who are not registered the designation NK (not known) in the registration number field is allowed if the wardfield is punched EXT, meaning an external case. Valid data are sorted and merged with existing data on disks. The data are then transferred to magnetic tape files which are maintained in two different formats—firstly, alphabetically (by patient surname for each hospital), and, secondly, in SNOP code order. The alphabetical and SNOP magnetic tape files are designed to be error-free within the predetermined criteria of the validation programme.

OUTPUT FROM COMPUTER

Lists of validated data are produced at weekly intervals. These indicate any records which are in error, and it is the responsibility of each laboratory to resubmit these records after correction and to check that the record is complete and up to date at

Fig. 1 Report form showing pattern of presentation of data to facilitate card punching.

CARD CODE	PATIENT NUMBER	SEX	DEPT/ WARD	SURNAME	FORE NAME		YEARS OF BIRTH	DATE OF SPECIMEN	LABORATORY NUMBER	CONSUL -TANT	SECTION/ PATHOLOG	DESCRIPTION	SHOP CODE
					1	2							
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9	9

HISTOPATHOLOGY
DATA POOL

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USAL 2622 DE BRAS 15

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Fig. 2 *Punch card routinely used by data pool.*

the end of the calendar year. A print-out in laboratory number order can be used to detect the occasional omitted record. The computer routinely produces a print-out at three-monthly intervals, when each laboratory receives an alphabetical print-out of its own data in patient surname order (Fig. 3). The print-out records data in the same order as on the punch cards except that the patient's age and not year of birth is recorded. In addition, each laboratory also receives at six-monthly intervals a copy of its own data printed in SNOP diagnostic code order (Fig. 4).

At the end of each year, after a check for completeness, a final cumulative print-out is prepared for each laboratory from the alphabetical and SNOP code tapes. This acts as a permanent record in each laboratory for reference. Retrieval of data to meet individual requirements is carried out on request.

Results

COMPUTER TECHNIQUES

The techniques are relatively simple and no serious difficulties have arisen.

ACCURACY OF DATA

The application of validation criteria to the data has focused attention on the difficulties in obtaining complete and accurate information. This is par-

ticularly so in the case of patient identity, and most laboratories rely entirely on the information recorded on request forms. The Queen Elizabeth Hospital, however, has an on-line hospital information system which allows checks to be made on the accuracy of patient identity. With its help assessments of the size of this problem were made.

The first test was made in June 1974 (Table 2). Of 147 patient requests which were received in one week 63% of request forms used preprinted self-adhesive identification labels and 37% were handwritten. A small number (14%) of the self-adhesive labels were inaccurate as a result of patients having changed wards or consultant. Fifty per cent of the hand-written forms showed errors variously affecting the name, age, sex, registration number, ward, and consultant. Explanation of the need for accuracy to operating theatre staff led to a progressive reduction from 27% to 12.5% in the number of request forms showing errors over a period of six months. The error rate of 12.5% recorded in January 1975 is probably less significant than at first seems apparent since, for the purposes of this survey, a discrepancy in any one letter or digit within a field (that is, name, registration number, etc) was counted as an error.

In practice only a small proportion of errors are so serious that a report fails to reach the patient's case record. Nevertheless, in computer processing

HISTOPATHOLOGY DATA POOL														PAGE 1	2/ 2/77
ALPHABETICAL REGISTER															
HOSP	SURNAME	FORE NAME	SEX	AGE	PATIENT REC NO	LAB ACC NUMBER	TYPE AND ORIGIN	PATHOL-LOGIST	CONSULTANT	WARD	DATE	SNOP CODE	DESCRIPTION		
GHH	ABSI	SH	F	11	NK	5355 75	WAX B10			EXT	1/12/75	6600 4101 0000 0000			
GHH	ACK	SI	M	59	080291	4650 75	SMEAR	A		0098	15/10/75	2701 6972 0000 0000			
GHH	ACTI	GA	F	20	175232	1833 75	WAX B10	W		1214	24/ 4/75	0100 8760 0000 0000			
GHH	ADA	MA	F	29	083504	1028 75	WAX B10	A		6046	7/ 3/75	8400 7831 0000 0000			
GHH	ADA	MA	F	43	136477	2126 75	WAX B10	A		6017	7 12/ 5/75	8400 7832 0000 0000			
GHH	ADA	MA	F	43	136477	2126 75	WAX B10	A		6017	7 12/ 5/75	8300 4610 0000 0000			
GHH	ADA	BA	F	40	075048	3391 75	WAX B10	A		6017	7 28/ 1/75	8400 7831 0000 0000			
GHH	ADA	CH	M	17	095669	5459 75	WAX B10	A		3097	8 10/12/75	6600 4101 0000 0000			
GHH	ADA	EV	F	55	049651	5285 75	WAX B10	W		6046	26/11/75	8400 8143 0000 0000			
GHH	ADA	EV	F	55	049651	5285 75	WAX B10	W		6046	26/11/75	8300 8143 0000 0000			
GHH	ADA	FR	M	64	025454	2076 75	WAX B10	A		3219	G 8/ 5/75	X900 0001 0000 0000			
GHH	ADA	JE A	F	31	069255	3126 75	WAX B10	A		6021	3 11/ 7/75	8610 0001 0000 0000			
GHH	ADA	JE	F	31	162255	311 75	WAX B10	A		6059	7 22/ 1/75	8400 7831 0000 0000			
GHH	ADA	RE	M	46	058383	355 75	WAX B10	A		3097	TGH 24/ 1/75	7400 8131 0000 0000			
GHH	ADA	RE	M	44	058383	206 75	SMEAR	A		3097	SEH 14/ 1/75	7100 0003 0000 0000			
GHH	ADA	V	F	20	116694	504 75	WAX B10	A		6059	7 5/ 2/75	8100 3540 0000 0000			
GHH	ADC	BE	F	44	026769	120 75	WAX B10	A		3264	TGH 9/ 1/75	0401 8143 0000 0000			
GHH	ADC	BE	F	43	026769	120 75	WAX B10	A		3264	TGH 9/ 1/75	0401 8143 0000 0000			
GHH	ADC	BE	F	42	172092	497 75	WAX B10	A		3264	9 4/ 2/75	0401 8143 0000 0000			
GHH	ADE	MA	F	31	173903	1448 75	WAX B10	W		6059	7 3/ 4/75	8610 2620 0000 0000			
GHH	AIR	SA	M	60	999999	4285 75	SMEAR	W		0310	10 2/ 9/75	2701 6971 0000 0000			
GHH	AIR	DO	F	68	179059	4709 75	WAX B10	W		3264	9 21/10/75	9600 8003 0000 0000			
GHH	ALBI	VE	F	55	075431	5217 75	WAX B10	W		6017	7 24/11/75	8400 7381 0000 0000			
GHH	ALB	VE	F	55	075431	5217 75	WAX B10	W		6017	7 24/11/75	8400 7306 0000 0000			
GHH	ALC	IV	F	73	158005	5509 75	SMEAR	W		9900	OPD 11/12/75	X821 0003 0000 0000			
GHH	ALD	JU	F	44	173997	4262 75	WAX B10	W		6059	7 24/ 9/75	8330 4000 0000 0000			
GHH	ALD	JU	F	43	273997	1804 75	WAX B10	W		6059	7 23/ 4/75	8400 7832 0000 0000			
GHH	ALD	JU	F	43	273997	1804 75	WAX B10	W		6059	7 23/ 4/75	8300 8600 0000 0000			
GHH	ALD	GE	M	67	180237	4060 75	WAX B10	W		0178	OPD 10/ 9/75	6301 4000 0000 0000			
GHH	ALD	GL	F	55	045391	2972 75	WAX B10	A		6059	7 2/ 7/75	8300 7381 0000 0000			
GHH	ALD	JA	M	55	176905	3344 75	WAX B10	F		0178	10 24/ 7/75	0600 8016 0000 0000			
GHH	ALD	JA	M	54	071905	3398 75	WAX B10	A		3219	10 24/ 7/75	X300 8016 0000 0000			
GHH	ALD	JA	M	54	171905	478 75	WAX B10	W		0178	DAR 31/ 1/75	5600 0001 0000 0000			
GHH	ALD	JA	M	54	171905	3178 75	WAX B10	A		3219	10 15/ 7/75	6200 4000 0000 0000			
GHH	ALD	NO	F	61	000663	4423 75	WAX B10	A		3097	OPD 3/10/75	0100 4712 0000 0000			
GHH	ALE	JE	F	24	085420	3603 75	WAX B10	W		6059	TGH 8/ 8/75	8400 7832 0000 0000			
GHH	ALE	KE	M	48	165186	4065 75	WAX B10	W		3013	OPD 10/ 9/75	0100 8760 0000 0000			
GHH	ALF	VI	M	26	175867	2367 75	WAX B10	W		3013	OPD 28/ 5/75	0401 9010 0000 0000			
GHH	ALL	WI	M	47	087012	155 75	WAX B10	W		3097	9 10/ 1/75	7800 9063 0000 0000			
GHH	ALL	MI	M	28	173549	1244 75	WAX B10	A		3097	8 19/ 3/75	6600 4101 0000 0000			
GHH	ALL	PE	M	59	168704	3414 75	WAX B10	A		3219	8 29/ 7/75	5600 5521 0000 0000			
GHH	ALL	PE	M	50	168704	277 75	WAX B10	W		0098	DAR 20/ 1/75	5600 5521 5512 0000			
GHH	ALL	PE	M	78	168704	253 75	WAX B10	W		0098	MUP 17/ 1/75	6201 0001 0000 0000			
GHH	ALL	GM	F	49	029582	4821 75	SMEAR	A		3097	OPD 28/10/75	0730 0003 0000 0000			
GHH	ALL	JE	F	53	172996	4426 75	WAX B10	A		6059	7 13/ 4/75	8400 7831 0000 0000			
GHH	ALL	ME	F	23	183054	4426 75	WAX B10	A		3264	TGH 6/10/75	6600 4101 0000 0000			
GHH	ALL	GR	M	35	181566	4323 75	WAX B10	A		4128	12 29/ 9/75	1500 5000 0000 0000			
GHH	ALL	AU	F	40	181324	4377 75	WAX B10	A		3097	LVM 1/10/75	0401 8143 0000 0000			
GHH	ALL	FR	M	66	166634	347 75	WAX B10	A		3013	8 24/ 1/75	5700 3100 0000 0000			
GHH	ALL	GL	F	49	166188	3948 75	SMEAR	W		6021	OPD 27 9/75	X831 0003 0000 0000			
GHH	ALL	GL	F	49	166188	3003 75	WAX B10	W		6021	7 3/ 7/75	8400 7306 0000 0000			
GHH	ALL	GL	F	49	166188	3003 75	WAX B10	W		6021	7 3/ 7/75	8330 0001 0000 0000			
GHH	ALL	IR	F	45	089330	1058 75	SMEAR	W		6021	OPD 7/ 3/75	X831 6970 0000 0000			
GHH	ALL	IR	F	45	089330	1964 75	WAX B10	A		6021	7 2/ 5/75	8300 4610 0000 0000			
GHH	ALL	IR	F	45	089330	1964 75	WAX B10	A		6021	7 2/ 5/75	8400 7831 0000 0000			
GHH	ALL	JE	F	43	109586	4920 75	WAX B10	W		6021	OPD 5/11/75	8400 7831 0000 0000			
GHH	ABS	SH	F	11	NK	5355 75	WAX B10			3264	EXT 1/12/75	6600 4101 0000 0000			
GHH	ACK	SI	M	59	080291	4650 75	SMEAR	A		0098	TGH 15/10/75	2701 6972 0000 0000			
GHH	ACTI	GA	F	20	175232	1833 75	WAX B10	W		1214	OPD 24/ 4/75	0100 8760 0000 0000			
GHH	ADA	MA	F	29	083504	1028 75	WAX B10	A		6046	TGH 7/ 3/75	8400 7831 0000 0000			
GHH	ADA	MA	F	43	136477	2126 75	WAX B10	A		6017	7 12/ 5/75	8400 7832 0000 0000			
GHH	ADA	MA	F	43	136477	2126 75	WAX B10	A		6017	7 12/ 5/75	8300 4610 0000 0000			
GHH	ADA	BA	F	40	075048	3391 75	WAX B10	A		6017	7 28/ 1/75	8400 7831 0000 0000			
GHH	ADA	CH	M	17	095669	5459 75	WAX B10	A		3097	8 10/12/75	6600 4101 0000 0000			
GHH	ADA	EV	F	55	049651	5285 75	WAX B10	A		6046	TGH 26/11/75	8400 8143 0000 0000			
GHH	ADA	EV	F	55	049651	5285 75	WAX B10	W		6046	TGH 26/11/75	8300 8143 0000 0000			
GHH	ADA	FR	M	64	025454	2076 75	WAX B10	A		3219	G 8/ 5/75	X900 0001 0000 0000			
GHH	ADA	JE A	F	31	069255	3126 75	WAX B10	A		6021	3 11/ 7/75	8610 0001 0000 0000			
GHH	ADA	JE	F	31	162255	311 75	WAX B10	A		6059	7 22/ 1/75	8400 7831 0000 0000			
GHH	ADA	RE	M	46	058383	355 75	WAX B10	A		3097	TGH 24/ 1/75	7400 8131 0000 0000			
GHH	ADA	RE	M	44	058383	206 75	SMEAR	A		3097	SEH 14/ 1/75	7100 0003 0000 0000			
GHH	ADA	V	F	20	116694	504 75	WAX B10	A		6059	7 5/ 2/75	8100 3540 0000 0000			
GHH	ADC	BE	F	44	026769	120 75	WAX B10	A		3264	TGH 9/ 1/75	0401 8143 0000 0000			
GHH	ADC	BE	F	43	026769	120 75	WAX B10	A		3264	TGH 9/ 1/75	0401 8143 0000 0000			
GHH	ADC	BE	F	42	172092	497 75	WAX B10	A		3264	9 4/ 2/75	0401 8143 0000 0000			
GHH	ADE	MA	F	31	173903	1448 75	WAX B10	W		6059	7 3/ 4/75	8610 2620 0000 0000			
GHH	AIR	SA	M	60	999999	4285 75	SMEAR	W		0310	10 2/ 9/75	2701 6971 0000 0000			
GHH	AIR	DO	F	68	179059	4709 75	WAX B10	W		3264	9 21/10/75	9600 8003 0000 0000			
GHH	ALBI	VE	F	55	075431	5217 75	WAX B10	W		6017	7 24/11/75	8400 7381 0000 0000			
GHH	ALB	VE	F	55	075431	5217 75	WAX B10	W		6017	7 24/11/75	8400 7306 0000 0000			
GHH	ALC	IV	F	73	158005	5509 75	SMEAR	W		9900	OPD 11/12/75	X821 0003 0000 0000			
GHH	ALD	JU	F	44	173997	4262 75	WAX B10	W		6059	7 24/ 9/75	8330 4000 0000 0000			

Fig. 3 Alphabetical print-out. Occasional discrepancies appear between laboratory number and patient age—for example, patient ADA-RE, age 46 and 44, laboratory numbers 355 and 206. These records refer to two specimens, one a biopsy the other cytology, from the same patient. The error in age arose on the request form. (The latter part of patient surnames is obliterated to preserve confidentiality.)

all errors are significant, since a difference in any one digit in patient identity means that the record is regarded as being from a different patient.

Accurate identification of specimens is easier

than patient identification since it is under the direct control of the laboratory. Errors are therefore rare and when they occur they are caused either by transposition of two numbers or by incorrect

PAGE 2		HISTOPATHOLOGY DATA SHEET										27/12/77	
SNOP CODING LIST													
SNOP CODE	HUSP	LAB ACC NUMBER	TYPE AND ORIGIN	PATHOL-LOGIST	DATE	AGE	SEX	SURNAME	FNRE NAME	PATIENT REG NO	CONSUL-TANT	WARD	DESCRIPTION
XY00 4300 0000 0000	EBH	2069 75	WAX	BIU	H	15/ 4/75	NK	F	HCL	MI 227043	4068	OPD	POLYP
XY00 4300 0000 0000	EBH	2915 75	WAX	BIU	H	22/ 5/75	61	M	PAR	JO 209397	4069	OPD	TISSUE LT EAR
XY00 4300 0000 0000	SCN	6389 75	WAX	BIU	X	25/ 9/75	44	M	DEA	JO E33565	4062	76	
XY00 4300 0000 0000	SWAR	3046 75	WAX	BIU	H	4/ 7/75	34	F	SAN	JR 180594	4061	WNT	POLYP
XY00 4300 0000 0000	SWAR	3433 75	WAX	BIU	B	8/ 8/75	50	F	PAD	EL 182079	4037	WNT	TISSUE
XY00 4300 0000 0000	SWAR	4464 75	WAX	BIU	H	5/11/75	21	M	JOH	JO 088188	4061	WNU	TISSUE
XY00 4300 0000 0000	SWAR	4649 75	WAX	BIU	H	15/11/75	36	F	SAN	JA 180594	4061	WNT	MASTOID
XY00 4400 0000 0000	SCN	484 75	WAX	BIU	O	22/ 1/75	52	F	WHI	MI L05221	4065	ADA	
XY00 4400 0000 0000	SWAR	2187 75	WAX	BIU	B	24/ 4/75	20	M	NIC	TE 106632	4061	WNU	GRANULATION TISSUE
XY00 4400 0000 0000	GHH	4403 75	WAX	BIU	A	3/10/75	25	M	LEE	MI 008680	4068	76	
XY00 4400 0000 0000	SWAR	3575 75	WAX	BIU	H	22/ 8/75	72	F	AUG	MA 122983	4037	WNT	AURAL POLYP
XY00 4400 0000 0000	SWAR	3797 75	WAX	BIU	B	18/ 9/75	14	M	PAN	KE 152468	4061	OPD	GRANULOMA OF MASTOID
XY00 4400 0000 0000	SWAR	3868 75	WAX	BIU	H	19/ 9/75	60	M	WIL	DA 099833	4037	WNU	AURAL POLYP
XY00 4414 0000 0000	SCN	3476 75	WAX	BIU	X	30/ 5/75	50	F	CHA	LI D11871	4043	12	
XY00 4414 0000 0000	SWAR	4573 75	WAX	BIU	H	14/11/75	22	F	TUR	LI 081541	4037	WNT	POLYP
XY00 4444 0000 0000	SCN	4604 75	WAX	BIU	X	17/ 7/75	45	F	WAL	MA 090391	4065	AL	
XY00 4444 0000 0000	SCN	5447 75	WAX	BIU	X	19/ 6/75	20	F	CUB	RD E60143	4042	63	
XY00 4444 0000 0000	SCN	8014 75	WAX	BIU	X	24/11/75	24	M	YAT	AL J11527	1216	SK1	
XY00 4524 0000 0000	GHB	96 75	WAX	BIU	A	9/ 1/75	73	M	PER	HA NK	4020	EXT	
XY00 4524 0000 0000	SWAR	1390 75	WAX	BIU	B	5/ 2/75	64	M	CAS	LE U34222	4061	OPD	BIOPSY RIGHT EAR
XY00 4524 0000 0000	SCN	4516 75	WAX	BIU	X	11/ 7/75	70	F	WIG	GL U30364	4043	CCP	
XY00 4524 0000 0000	SCN	6088 75	WAX	BIU	X	15/ 9/75	28	F	BOU	PA E41625	4042	63	
XY00 4524 0000 0000	SCN	7943 75	WAX	BIU	F	20/11/75	38	M	WAT	DE W02727	4043	12	
XY00 7221 0000 0000	SCN	2113 75	WAX	BIU	X	2/ 4/75	16	F	HIL	RU E54197	3000	SUR	
XY00 7322 0000 0000	SCN	3031 75	WAX	BIU	X	12/ 5/75	78	M	BIR	WI E16972	5122	3	
XY00 7322 0000 0000	SCN	6307 75	WAX	BIU	X	23/ 9/75	81	M	SHO	JE U05357	1203	SK1	
XY00 7329 0000 0000	SCN	115 75	WAX	BIU	X	8/ 1/75	59	F	PRU	JA 190589	4043	12	
XY00 7329 0000 0000	SCN	1409 75	WAX	BIU	X	4/ 3/75	14	M	SMI	JO E67404	4042	63	
XY00 7329 0000 0000	SCN	1498 75	WAX	BIU	X	5/ 3/75	81	F	WAG	GO 009530	4065	OPD	
XY00 7329 0000 0000	EBH	1593 75	WAX	BIU	H	21/ 3/75	11	M	SMI	ME 177194	4068	WNU	RT MASTOID
XY00 7329 0000 0000	EBH	2 75	WAX	BIU	F	1/ 1/75	51	M	GRE	MI 216540	4068	WNU	POLYP LT EAR
XY00 7329 0000 0000	EBH	1169 75	WAX	BIU	H	4/ 3/75	15	M	HAR	MI 225471	4069	WNU	BIOPSY ANTRUM
XY00 7329 0000 0000	SCN	1873 75	WAX	BIU	X	21/ 3/75	11	M	HIG	JA E66000	4065	EXT	
XY00 7329 0000 0000	EBH	1824 75	WAX	BIU	H	24/ 2/75	44	M	WIL	MI 223797	4061	WNT	BIOPSY LT EAR
XY00 7329 0000 0000	SCN	5402 75	WAX	BIU	T	15/ 8/75	98	F	BEA	JO E83276	4065	12	
XY00 7329 0000 0000	EBH	4578 75	WAX	BIU	H	24/ 7/75	17	M	SHO	JA 194213	4069	OPD	RT EAR
XY00 7348 0000 0000	SCN	6855 75	WAX	BIU	X	13/10/75	52	M	GIB	KE U93655	1216	SK1	
XY00 7381 0000 0000	SCN	2534 75	WAX	BIU	X	22/ 4/75	31	M	WIG	JA U04607	4042	63	
XY00 7381 0000 0000	SCN	3335 75	WAX	BIU	X	22/ 5/75	23	M	PAR	MI E65462	4043	12	
XY00 7381 0000 0000	SCN	594 75	WAX	BIU	X	7/ 2/75	28	F	BOU	PA E41625	4042	63	
XY00 7381 0000 0000	SCN	4902 75	WAX	BIU	X	15/10/75	33	M	WAT	DE 019500	4043	12	
XY00 7381 0000 0000	SCN	4435 75	WAX	BIU	Y	10/12/75	74	F	FAL	JA E46104	4042	63	
XY00 8072 0000 0000	SCN	6778 75	WAX	BIU	X	4/10/75	63	M	FAL	JA U05439	5151	EXT	
XY00 8073 0000 0000	SCN	2258 75	WAX	BIU	X	10/ 4/75	52	M	STR	JE E71462	4042	63	
XY00 8073 0000 0000	SCN	6132 75	WAX	BIU	X	17/ 9/75	51	M	STR	JE E71462	4042	63	
XY00 8073 0000 0000	SCN	6265 75	FRU	BIU	X	22/ 9/75	51	M	STR	JE E71462	4042	63	
XY00 8073 0000 0000	SCN	6265 75	FRU	BIU	X	22/ 9/75	51	M	STR	JE E71462	4042	63	
XY00 8073 0000 0000	SWAR	4205 75	WAX	BIU	H	26/10/75	65	M	CAS	JE U34222	4061	WNU	RIGHT EAR BIOPSY
XY00 8073 0000 0000	SWAR	4993 75	WAX	BIU	H	27/12/75	65	M	BOU	JA 174968	4037	WNU	EAR BIOPSY
XY00 8093 0000 0000	SCN	5272 75	WAX	BIU	X	21/ 5/75	44	F	PRE	JE E42607	4018	WNT	
XY00 8093 0000 0000	SCN	1966 75	WAX	BIU	X	2/ 3/75	14	M	HIL	MI NK	4040	EXT	
XY01 0003 0000 0000	SCN	5179 75	WAX	BIU	F	2/ 2/75	54	M	BOU	JA E70457	4043	12	
XY01 0003 0000 0000	SCN	9005 75	SMFA		T	11/ 1/75	65	M	WIG	TH U42674	4053	7	
XY01 0003 0000 0000	SCN	9008 75	SMFA		T	10/ 2/75	65	M	WIG	JE E47164	4056	7	
XY01 0003 0000 0000	SCN	9008 75	SMFA		T	10/ 2/75	65	M	WIG	JE E47164	4056	17	
XY00 4300 0000 0000	EBH	2069 75	WAX	BIU	H	15/ 4/75	NK	F	HCL	MI 227043	4068	OPD	POLYP
XY00 4300 0000 0000	EBH	2915 75	WAX	BIU	H	22/ 5/75	61	M	PAR	JO 209397	4069	OPD	TISSUE LT EAR
XY00 4300 0000 0000	SCN	6389 75	WAX	BIU	X	25/ 9/75	44	M	DEA	JO E33565	4062	76	
XY00 4300 0000 0000	SWAR	3046 75	WAX	BIU	H	4/ 7/75	34	F	SAN	JR 180594	4061	WNT	POLYP
XY00 4300 0000 0000	SWAR	3433 75	WAX	BIU	B	8/ 8/75	50	F	PAD	EL 182079	4037	WNT	TISSUE
XY00 4300 0000 0000	SWAR	4464 75	WAX	BIU	H	5/11/75	21	M	JOH	JO 088188	4061	WNU	TISSUE
XY00 4300 0000 0000	SWAR	4649 75	WAX	BIU	H	15/11/75	36	F	SAN	JA 180594	4061	WNT	MASTOID
XY00 4400 0000 0000	SCN	484 75	WAX	BIU	O	22/ 1/75	52	F	WHI	MI L05221	4065	ADA	
XY00 4400 0000 0000	SWAR	2187 75	WAX	BIU	B	24/ 4/75	20	M	NIC	TE 106632	4061	WNU	GRANULATION TISSUE
XY00 4400 0000 0000	GHH	4403 75	WAX	BIU	A	3/10/75	25	M	LEE	MI 008680	4068	76	
XY00 4400 0000 0000	SWAR	3575 75	WAX	BIU	H	22/ 8/75	72	F	AUG	MA 122983	4037	WNT	AURAL POLYP
XY00 4400 0000 0000	SWAR	3797 75	WAX	BIU	B	18/ 9/75	14	M	PAN	KE 152468	4061	OPD	GRANULOMA OF MASTOID
XY00 4400 0000 0000	SWAR	3868 75	WAX	BIU	H	19/ 9/75	60	M	WIL	DA 099833	4037	WNU	AURAL POLYP
XY00 4400 0000 0000	SWAR	3868 75	WAX	BIU	H	19/ 9/75	60	M	WIL	D 099833	4037	WNU	AURAL POLYP
XY00 4414 0000 0000	SCN	3476 75	WAX	BIU	X	30/ 5/75	50	F	CHA	LI D11871	4043	12	
XY00 4414 0000 0000	SWAR	4573 75	WAX	BIU	H	14/11/75	22	F	TUR	LI 081541	4037	WNT	POLYP
XY00 4444 0000 0000	SCN	4604 75	WAX	BIU	X	17/ 7/75	45	F	WAL	MA 090391	4065	AL	
XY00 4444 0000 0000	SCN	5447 75	WAX	BIU	X	19/ 6/75	20	F	CUB	RD E60143	4042	63	
XY00 4444 0000 0000	SCN	8014 75	WAX	BIU	X	24/11/75	24	M	YAT	AL J11527	1216	SK1	
XY00 4524 0000 0000	GHB	96 75	WAX	BIU	A	9/ 1/75	73	M	PER	HA NK	4020	EXT	
XY00 4524 0000 0000	SWAR	1390 75	WAX	BIU	B	5/ 2/75	64	M	CAS	LE U34222	4061	OPD	BIOPSY RIGHT EAR
XY00 4524 0000 0000	SCN	4516 75	WAX	BIU	X	11/ 7/75	70	F	WIG	GL U30364	4043	CCP	
XY00 4524 0000 0000	SCN	6088 75	WAX	BIU	X	15/ 9/75	28	F	BOU	PA E41625	4042	63	
XY00 4524 0000 0000	SCN	7943 75	WAX	BIU	F	20/11/75	38	M	WAT	DE W02727	4043	12	
XY00 4524 0000 0000	SCN	2113 75	WAX	BIU	X	2/ 4/75	16	F	HIL	RU E54197	3000	SUR	
XY00 7221 0000 0000	SCN	2113 75	WAX	BIU	X	2/ 4/75	16	F	HIL	RU E54197	3000	SUR	
XY00 7322 0000 0000	SCN	3031 75	WAX	BIU	X	12/ 5/75	78	M	BIR	WI E16972	5122	3	

Fig. 4 SNOP diagnostic code order print-out. (The latter part of patient surnames is obliterated to preserve confidentiality.)

copying from the request form to the report form. These errors, while not unimportant, are less vital than errors in patient identity, since the most important aspect of the record is the ability to couple the correct diagnosis with the appropriate patient.

A further source of error arises from the structure

of the SNOP code and the way in which codes are allocated. The code consists of four fields—Topography (T), Morphology (M), Aetiology (E), and Function (F)—each having four digits. Each field has a branching structure with finer subdivisions in the field leading to a specific meaning when all four digits are used—for example, M8143 denotes

Table 2 Survey of errors in patient identity as recorded on request forms and effect of explaining need for accuracy to operating theatre staff

Month/year	Sample size	No of errors	No. of forms affected	% of forms affected	% of forms with label
June 1974	147	48	40	27	63
November 1974	116	34	24	21	72
January 1975	169	22	21	12	67

Table 3 Errors in coding and their origin detected in data retrieved for other purposes

	1971		1975	
	Number	Percentage	Number	Percentage
No. of diagnoses	304	100	327	100
Typographical errors	3	0.99	2	0.61
Pathologist coding errors	9	2.96	—	—
Coding discrepancies	7	2.3	12	3.67

primary adenocarcinoma. Three main types of coding errors were found during periodic assessments of retrieved data (Table 3): (1) typographical errors (1%) due to misreading of poor handwriting and the transposition of digits; (2) miscoding by the pathologist (0.3%) either through misreading a code or failing to remember a familiar code correctly; and (3) the SNOP system allows a lesion to be coded in more than one way and a pathologist may allocate a code which is different from that allocated by another pathologist for the same lesion (2.4%).

Inflammatory lesions are particularly prone to the type of problem stated in (3). It is minimised by the use of a bench 'visual aid'.

Usually the T and M fields are adequate for coding a given diagnosis and a remarkably small proportion of the many thousands of codes available in the large coding manual is sufficient for everyday use. The SNOP visual aid, which is a synopsis of commonly used codes, is available but it did not entirely suit our needs. Therefore in 1971 we compiled our own. This included topographic and morphology codes along with a small number of codes to denote aetiology and function. Of the 842 morphology codes in the visual aid 50% were sufficient to provide 98% of diagnoses and the pathologist's workload in coding his diagnosis was correspondingly reduced. The Royal College of Pathologists (1975) has produced a similar visual aid designed to meet the needs of histopathology laboratories (*Systematised Nomenclature of Pathology: A Bench Synopsis*). The use of a visual aid encourages uniformity of coding since the choice of codes applicable to a particular lesion is much more restricted.

RETRIEVAL

Data can be readily retrieved from the routine print-out when the requirement is straightforward, but when more complex retrieval and analyses are required the computer is used. The cumulative print-out provides a means of rapid retrieval of data about individual patients for follow-up and review. In addition, retrieval of significant numbers of a par-

Table 4 Topographic distribution by age of cutaneous squamous carcinoma from the Birmingham Histopathology Data Pool, 1971-76

Site	Age (years)									
	≤9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	≥90
Scalp	—	—	—	—	1	3	4	3	4	15
Forehead	—	—	—	—	—	—	1	1	—	2
Face	—	—	—	—	1	12	20	22	17	73
Nose	—	—	—	—	—	1	1	1	1	4
Lip	—	—	—	—	—	1	3	—	—	4
Ear	—	—	—	—	—	1	15	8	6	32
Neck	—	—	—	—	—	1	4	2	1	9
Shoulder	—	—	—	—	—	—	—	—	—	—
Arm	—	—	—	—	—	2	2	3	2	10
Hand	—	—	—	—	—	2	13	14	9	38
Chest	—	—	—	—	—	—	1	1	1	3
Back	—	—	—	—	—	—	1	—	—	1
Abdomen	—	—	—	—	—	—	—	1	—	1
Vulva	—	—	—	—	1	—	1	2	—	5
Scrotum	—	—	—	—	—	2	3	—	—	5
Anus	—	—	—	1	1	7	13	1	2	26
Thigh	—	—	—	1	—	—	2	2	3	8
Knee	—	—	—	—	1	—	1	—	1	3
Lower leg	—	—	1	—	1	1	11	9	3	27
Foot	—	—	—	—	—	—	3	—	—	3
Totals	—	—	1	2	6	33	99	70	50	269

ticular lesion occurring at a single anatomical site is possible from the SNOP ordered file. This is of particular value not only for teaching but also for purposes such as reviewing the histological features of a lesion when establishing a diagnosis is difficult or testing a new staining technique on existing material.

Retrieval from the computer is done at the request of the pathologist either for his own purposes or on behalf of clinicians. A request form stating the information required is sent to the computer department, and the most suitable method of retrieving the information required may be discussed with the pathologist to ensure accuracy of retrieval. The following three major types of retrieval have been used.

(1) Searches on the basis of a single code or group of codes. For the pathologist this usually means retrieval of a lesion occurring at a number of different anatomical sites, something that is difficult with a manual system. Similarly, a group of cases of interest to a particular clinician can be retrieved on the bases of the consultant code and appropriate SNOP code.

(2) Detailed analysis of large volumes of data. This may be illustrated by reference to specific examples.

Table 5 *Comparisons in diagnosis of frozen sections and paraffin sections in 482 diagnoses of 424 frozen sections from the Queen Elizabeth Hospital, October 1970 to December 1971*

Diagnosis*	
Frozen section	Paraffin section
Breast duct papilloma	Fibroepithelial hyperplasia
Breast fibroadenoma (2 cases)	Fibroepithelial hyperplasia
Breast sclerosing adenosis	Carcinoma
Lymph node plasmacytoma	Inflammatory reaction
Parathyroid, Abnormal (2 cases)	Adenoma

*Diagnosis modified in 35 cases and changed in seven.

Table 6 *Modifications added to the system in the light of previous limitations*

Card column	Future usage
57-60	User codes: 4 characters—information of interest to individual laboratory recorded without reference to other users
61	Single character code denoting specimens of particular interest: 1 = photographed, 2 = preserved, 3 = good teaching case, 4 = 1 and 2, 5 = 1 and 3, 6 = 2 + 3, 7 = 1 and 2 and 3
62	Single character code indicating wish to follow up later after appropriate reminder from computer
63	Single character code allowing pathologist to grade a lesion
64	Single character code indicating provisional (1) or uncertain (2) diagnosis. 3 = 1 and 2

(a) The frequency with which the malignant form of pleomorphic salivary tumour was diagnosed relative to other salivary gland tumours was investigated and found to be 6.5%—greater than expected (Evans and Cruikshank, 1970). Examination of the data showed that the incidence was in fact no greater but that some pathologists had tended to code as malignant a number of recurrent tumours which were not frankly malignant but showed suspect histological and cytological features. This was probably an inappropriate use of the code in the strictest sense, but it illustrates the importance of the pathologist coding his own diagnoses. In doing so he allocates the code which he considers most appropriate, whereas if he delegates the task to non-medical personnel he has to rely on their interpretation of his findings and thereby increases the margin for error.

(b) By plotting scattergrams of patients' ages against the anatomical site of a lesion (Alexander, personal communication 1975) atypical cases may be identified. In the case of squamous carcinoma of skin a scatter of cases was found (Table 4) with most lesions located in the upper part of the body in older patients. Lesions which fall outside the main grouping are worthy of further investigation in order to assess the accuracy of the initial diagnosis or the presence of other predisposing factors such as industrial exposure.

(c) The sex and age distribution of different morphological lesions occurring at a single anatomical site can be compared and patterns worthy of further study may emerge. For example, the age distribution in men for histologically normal appendices was identical with that for acutely inflamed appendices whereas in women two distinct patterns were found, presumably because a normal appendix is sometimes removed from a woman at laparotomy for abdominal pain due to gynaecological causes. This finding of a similar population distribution in the male might represent disease at a stage before the development of overt acute appendicitis as assessed by conventional histological criteria.

(3) Data from a particular laboratory can be retrieved and analysed for patterns of work. For example, the number of patient requests submitted for frozen section, cytological examination, and routine paraffin section examination can be determined and, by reference to the source of the request and the final diagnosis, the pattern of the workload of a laboratory in relation to the source and type of work performed can be determined. This approach offers an easy method of comparing frozen section and paraffin section diagnoses (Table 5). Moreover, retrieval of cytology and subsequent biopsy for

both comparative and follow-up purposes is facilitated since all records for a particular patient within a single year are located together within the alphabetical file.

CONFIDENTIALITY

The diagnostic information in computer print-outs and on the magnetic tapes is in code and unintelligible without knowledge of the coding system and access to coding manuals. Consequently the use of a computer does not increase the problem of confidentiality which already exists with the long-term storage of reports in laboratories and their use throughout hospitals and cancer registries. When a pathologist wishes to restrict the information various parts of the record can be deleted as it is printed from the magnetic tape files.

FUTURE DEVELOPMENT

In November 1976 the system was transferred to a Univac 418-III computer. This machine's greater capacity has several advantages, the most important of which is the ability to maintain all data for a whole year on a single file in alphabetical order from which a print-out in any predetermined order can be prepared. More rapid retrieval of data and more complex analyses are also possible. The change from one machine to another meant extensive reprogramming, which led to a critical review of the system and to improvements. The most important of these concern the specimen description fields, columns 46-64 on the punch card (Table 6). Further modifications affect the output of data. The validation listings will be printed monthly instead of weekly in alphabetical order in order to supplement the three-monthly alphabetical print-out.

Since the data pool records more than 40 000 diagnoses a year the physical size of print-out of the SNOP diagnostic file is too large for easy handling and it will be limited to the information from individual laboratories in the same way as the alphabetical listing. Finally, the transfer to the Univac 418-III computer means that the capacity of the computer is no longer a constraint and the data pool can now expand more rapidly. Experience suggests that a data pool serving all laboratories in a region is feasible and would have many advantages over a small pool.

Discussion

Since its inception in 1970 the Birmingham Histopathology Data Pool has acquired a large volume of data. Significant numbers of a range of uncommon lesions are now on file and available for comparison and research purposes. The system provides an

efficient method of maintaining index files in patient name (alphabetical) and disease (SNOP code) order, and the printed version of the files containing the information from individual laboratories provides an easy-to-use reference system giving access to information about specimens examined in the various laboratories. The data concerning cases of a particular lesion can be retrieved and analysed within defined limits. These data can be sorted into any order so that similar cases or specific features of one type of case come together and the task of the individual who has requested the retrieval is simplified.

Our experience with the computer-based data pool contrasts favourably with the experience of operating indexes and laboratory report files maintained in traditional ways. The latter generally consists of patient name and disease indexes and use copies of reports filed in laboratory number. They often work well for short-term reference but as information accumulates over the years more and more effort is required to search this type of file. Moreover, the information retrieved is incomplete. In the computer-based system the laboratory report files are maintained as in manual systems but the patient name and disease indexes are maintained by the computer.

The disease index can be more detailed than in a manually operated system since the problems associated with retrieval from manual systems are insignificant. Our experience also shows that files maintained on the computer are more accurate than manually maintained files because the computer program checks for accuracy within the predetermined criteria of the validation program and rejects records which it considers to be inaccurate or incomplete.

Computer retrieval and analysis of groups of cases is invaluable in establishing the incidence of various conditions within different areas, and thus in supplying important epidemiological information for all types of lesions similar to that already provided for neoplasms by cancer registries. The potential of this aspect will be fully realised only when the majority of hospitals in a region submit data.

A variety of other uses are possible—for example, the diagnostic habits of a laboratory can be determined and compared with those of other laboratories in the whole data pool. Thus, by monitoring the work performed by a laboratory and observing any change or trends, the pathologist can use this approach as a form of quality control or quality assurance. This approach to quality assurance has hardly been explored so far but promises to be of greater value to the practising histopathologist than

current methods, which are usually based on his performance in diagnosing a series of difficult test sections, often prepared in an unfamiliar way and taken out of their clinical context. As part of the same monitoring process the effectiveness of different diagnostic techniques such as frozen sections versus paraffin sections may be compared.

Occasional discrepancies occur in the choice of codes for similar lesions between laboratories and between individual pathologists, partly because of the wide range of codes available to the pathologists in the complete SNOP manual. The use of a more limited range of agreed codes in the bench visual aid has helped to make the choice of the code for a particular lesion more consistent. Greater uniformity of coding could also be achieved either by a team of suitably trained coding clerks or by using an automatic coding system such as that developed by Coles and Slavin (1976). The use of non-medical personnel, however, adds to the expense and increases the risk of serious errors in coding through misinterpretation of words or phrases in a report. The alternative of automatic coding from free-text diagnosis requires diagnoses to be in a standard SNOP format. Since such a system is not yet fully developed a proportion of diagnoses have to be coded manually. Until this type of system has been fully developed and evaluated the practice in the Birmingham scheme will be for the pathologist to allocate the code considered most appropriate on the basis of the histological features.

Ten hospitals contribute to the Birmingham Histopathology Data Pool. We hope that the benefits of participation will encourage others to join. The number of hospitals that can usefully contribute to a data pool is virtually unlimited in terms of the computer capacity available, but for administrative reasons the most suitable size would

seem to be one health region. This has the added advantage of being the area covered by most regional cancer registries.

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