Thus, in these ways clinical virology provides fields where routine and research work may profitably coexist hand in hand, much rewarding research stemming from properly collected specimens from well-documented cases.

Summary

A diagnosis was made on 96 (36.6%) of 262 patients referred for virological investigations between 21 January 1966 and 20 January 1967. The highest numbers of patients were referred by the departments of paediatrics and venereology and from the physician in charge of nurses' health. The highest diagnostic rates were achieved on those patients referred by the nurses' physician (46.4%) and by the paediatricians (44.4%). Investigations on women exposed to or contracting rubella in early pregnancy, on infants with congenital malformations or neonatal infections, and on exanthematous infections which presented atypically were thought to be among the most useful studies conducted. Difficulties encountered in providing a fully comprehensive diagnostic service are described, and emphasis is placed on the importance of conducting epidemiological, clinical, and virological studies on carefully selected material alongside routine diagnostic investigations.

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COMPUTERS IN MEDICINE

Notification of Death Occurring after Discharge from Hospital

M. R. HUBBARD*; E. D. ACHESON,† M.A., D.M., F.R.C.P.

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Although the fact of death has been recorded in practically all instances in this country since the Registration Act of 1837, and a quarterly alphabetical index of persons dying is maintained at Somerset House by the Registrar General, it may still be difficult for a doctor to discover which of a group of patients treated by him has since died. This paper describes an experiment in the systematic notification of deaths occurring after discharge to the hospitals in the Oxford area by a computer method.

Material and Method

Since the beginning of 1962 data from records of every birth, admission to hospital, and death in the population of Oxford and the surrounding area have been abstracted, coded, punched on cards, and matched into personal cumulative files (Acheson, 1964, 1967). This paper deals with hospital discharges and deaths in the defined population during 1963 and 1964. During these years the electromechanical system of data-processing set up in 1962 was replaced by a computer system.

Two cards are punched for each event—an identification card, containing the name, date of birth, N.H.S. number (if known), and other identifying data, and a statistics card carrying coded diagnostic and administrative information. The data are read on to magnetic tape, and edited. They are then sorted into sequence by using the Russell-Soundex phonetic code, sex, and initial as the sorting items, and each new record is compared with all

records in the equivalent subdivision of the master file. The system of record linkage is based on the principles described by Newcombe, Kennedy, Axford, and James (1959), whereby discrepant records are dealt with by allotting appropriate weighting factors (positive or negative) to agreements and discrepancies.

The product of the record linkage programme is a compound cumulative file which contains one entry for each person encountered by the system, each consisting of identification data and the records of a variable number of the defined events.

The next step was to scan the master file for all patients whose records included a death certificate and to write these records on to a separate magnetic tape. Records were selected from this tape for patients who had died in 1963 or 1964 and who had been discharged from hospital once or more in that period. An item was then formed for each discharge containing the following data: identification of patient, date of discharge, date of death, diagnosis on discharge (hospital record), and cause of death (death certificate).

If the patient died while in a hospital all items relating to that hospital were deleted, as it was assumed that the hospital was bound to be aware of the death. To avoid multiple notifications of a death where a patient had been discharged more than once from a hospital, the record of the final discharge was the only one retained. By means of the appropriate sorting lists of persons discharged from hospital within the two-year period who died at home or in another hospital were then prepared for each hospital and printed in alphabetical order of surname. Two years after the last death in the series had occurred—that is, at the end of 1966—the lists were sent to the medical records officer of each hospital in the area.

* Computer Scientist.

† May Reader in Medicine.

The Oxford Record Linkage Study, Nuffield Department of Clinical Medicine, University of Oxford.

Results

A facsimile of a section of one of the listings is shown in the accompanying Figure, the surnames having been changed to maintain confidence. From left to right are written the names of the patient, the N.H.S. number, the date of the last discharge from the hospital, the code number of the principal diagnosis reached at that time, the date of death, and the code

had been taken to ascertain death when it occurred after discharge, both by following up missed outpatient appointments and by scanning the obituary columns of the local papers. The ineffectiveness of these measures came as a surprise. The only hospital with complete information was the chest hospital, which, perhaps because of a long tradition of following up patients with tuberculosis, made a systematic study of the quarterly death returns from the medical officer of health.

HOSPITAL 10

THE FOLLOWING PERSONS HAVE BEEN NOTIFIED AS DEAD

HOSPITAL NUMBER	SURNAME	FIRST FORENAME	SECOND FORENAME	NHS NO.	DATE OF DISCHARGE	DIAGNOSIS	DATE OF DEATH	CAUSE OF DEATH
35781	CARSWELL	FLORENCE	MAR.	QRZZ 9999	16.04.63	712	22.12.63	420.1
84800	JACOBS	HENRY			22.09.63	420.1	23.08.63	420.1

Facsimile of section of the record.

number of the underlying cause of death as stated on the death certificate.

Table I shows the proportion of deaths about which the various hospitals had been informed before receipt of the listing. Small country hospitals without records departments were excluded from this analysis. Taken overall, a little more than one-third (38.4%) of the deaths had already been notified. The substantially higher proportion of notified cases in the special hospitals (63.4%) was due to the practice at the hospital for chest diseases of searching a complete return of death certificates supplied quarterly by the medical officer of health for the names of old patients. In a previous analysis (Acheson, 1967) it was shown that the proportions of deaths notified were as great in those not dying of cancer as in those dying of this condition—that is, the deficiency was not due to the assumption of death in terminal cases.

In Table II a sample of the cases has been classified according to the time interval elapsing between discharge and death. Though the trend is irregular, the proportion of deaths known to the hospitals falls off as the time interval between discharge and death increases ($\chi^2=15.85$; $P<0.01$). Nevertheless, almost half the deaths occurring within one month of discharge had gone unrecorded in the records departments of the hospitals concerned.

Discussion

An interesting feature of this study was that it uncovered a deficiency in communication of which the hospitals themselves were unaware. In the two principal groups considerable pains

Another specialist hospital knew of none of the deaths which had occurred after discharge.

The possible usefulness of feeding back this type of information to hospitals may be considered under three headings—namely, its administrative value; its value to research workers; and its possible importance to the clinician in his evaluation of the correctness of the diagnosis, the effectiveness of the treatment, and the accuracy of the prognosis which he had given.

From the administrator's point of view notification of death means that the patient's dossier can be completed and be retired to relatively inexpensive filing space. The risk of importuning the relatives with correspondence addressed to a person who is dead will be avoided. Also, the advantage of accurate notification of death to the clinical research worker is obvious.

It is more difficult to be certain of the value of the data to the clinician himself, and it is proposed to mount a more detailed clinical study of a sample of the deaths with such an evaluation in mind. Preliminary analysis suggests that the majority of the deaths will prove either to have been more or less inevitable or to be irrelevant from the standpoint of the clinician in charge of the final episode of inpatient treatment. However, a minority of the reports are likely to prove of considerable interest in that they may influence the clinician in the treatment of similar cases in future.

If it were thought desirable to provide this type of service on a regular and extended scale, this could be done either by a system of linked records or by asking for the name of the hospital from which the deceased person had been discharged to be recorded on the death certificate. Table II suggests that the service might reasonably be limited to hospitals from which the patient had been discharged within the 12 months before death.

Summary

Only one-third of the deaths occurring within a two-year period after discharge from a group of hospitals had been recorded in the hospital notes of the patients concerned; of those occurring within one month of discharge from hospital one-half had been recorded. The possible merits of supplying the missing data are discussed from the administrative and clinical points of view.

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TABLE I.—Numbers and Proportions of Deaths Occurring After Discharge from Hospital Not Noted in the Hospital Records

	Deaths Known to Hospital		Deaths Not Known to Hospital		Total
	No.	%	No.	%	
Teaching hospitals ..	362	35.2	677	64.8	1,039
District hospital ..	58	40.0	87	60.0	145
Mental hospitals ..	16	29.6	38	70.4	54
Specialist hospitals ..	90	63.4	52	36.6	142
All hospitals ..	526	38.4	854	62.3	1,380

TABLE II.—Effect of the Interval Between Discharge and Death on the Proportion of Deaths Known to the Hospital

Interval Between Discharge and Death	Death Known to Hospital		Death Not Known to Hospital	Total
	No.	%		
1 month ..	52	50.0	52	104
2-3 months ..	71	39.7	108	179
4-6 months ..	35	26.7	96	131
7-12 months ..	40	40.1	58	98
1 year + ..	10	27.0	27	37
Total ..	208	37.9	341	549