

# Middle Articles

## GENERAL PRACTICE OBSERVED

### Use by General Practitioners of Obstetric Beds in a Consultant Unit: Report of First 500 Cases

K. L. OLDERSHAW,\* M.B., B.S., D.OBST.R.C.O.G.; J. M. BRUDENELL,† M.B., B.S., F.R.C.S., M.R.C.O.G.

*Brit. med. J.*, 1968, **3**, 112-116

The S.E. sector of London within a radius of 5 miles (8 km.) from Lambeth is served by 10 consultant obstetric units. There are no existing general-practitioner maternity units, and none planned, so that with the hospital confinement rate at 80% opportunities for the general practitioner interested in obstetrics are limited.

As a result of discussions in one of the local maternity liaison committees (see Oldershaw, 1965) a scheme was initiated to allow general practitioners the use of some of the existing consultant obstetric beds.

This paper deals with the first 500 deliveries supervised by general practitioners (G.P.s) in the consultant obstetric units of Dulwich and St. Giles Hospitals, now both part of King's College Hospital. The deliveries were consecutive, only abortions and those patients who moved away being excluded.

#### General Principles of Scheme

(1) Only general practitioners on the obstetric list were invited to participate in the scheme.

(2) Only women who at the time of booking had unsuitable home conditions and fulfilled the criteria for a home confinement or confinement in a G.P. maternity home, as suggested in the Report on Confidential Enquiries into Maternal Deaths in England and Wales, 1958-1960 (p. 47), could be considered for booking by the G.P. However, where an abnormality had occurred in a previous pregnancy, but the risk of recurrence was small, the fact that delivery would take place in a consultant unit was considered an adequate safeguard. Each of these cases was referred to the consultant before booking and his express permission obtained.

(3) The consultant obstetrician retained sole responsibility for the patients, the G.P. working under his general direction and consulting freely with him at all times.

(4) Each G.P. had an honorary contract with the hospital and was obliged to be a member of a recognized medical defence organization.

#### Details of Scheme

The G.P. books a bed at the hospital for suitable patients by telephoning the maternity sister in charge of bookings.

The initial antenatal examination is performed by the G.P. Blood is taken for routine testing and a chest x-ray examination arranged. The results are entered on a co-operation card

\* General Practitioner, London S.E.23.

† Consultant in Obstetric and Gynaecological Surgery, King's College Hospital, London S.E.5.

(MCW 266) by the doctor, and bearing this card the patient attends the hospital booking clinic. Details on the co-operation card needed by the hospital are entered in the hospital records. An ambulance card is issued, and any other arrangements—for example, for 48-hour discharge or for mothercraft classes—are made at this time. The patient then attends the G.P. in his surgery for antenatal care until at the 34th week she returns to the hospital to be seen by the consultant or his registrar, and her continuing suitability for G.P. care is confirmed. Thereafter the antenatal care is continued by the G.P.

At the onset of labour the patient is admitted to the hospital in the usual way, and the G.P. is so informed. Responsibility for the management of the labour rests with the G.P., who is expected to be present at the confinement when possible. The actual delivery, if normal, is usually performed by a pupil midwife or medical student. During the lying-in period the patient is under the care of the G.P., who is also responsible for the care of the baby, under the direction of the consultant paediatrician. The postnatal examination is carried out by the G.P. at his surgery.

Should an abnormality develop at any time, the G.P. consults with the consultant or the registrar, and three courses of action are possible, depending on the seriousness of the abnormality and the experience of the G.P.: (1) the case remains under the care of the G.P., who takes whatever action has been advised; (2) the case ceases to be a G.P. case, the consultant takes over and the G.P. withdraws; and (3) the care of the patient is shared between the consultant and the G.P., the latter becoming, in practice, an extra house-officer.

#### Results

To date, 481 women have been delivered of 500 babies. There have been no maternal deaths; perinatal deaths numbered 6, a rate of 12 per thousand. Table I shows that the majority of cases delivered satisfied the criteria regarding age and parity. In a minority special circumstances existed, and consultant approval was obtained before booking the patient under the scheme.

TABLE I.—*Confinements: By Age and Parity. 481 Women Delivered of 500 Babies, 15 Women Being Delivered Twice and There Being Four Pairs of Twins*

Age	Parity									
	0	1	2	3	4	5	6	7		8
<21	85	29	6							120
21-30	118	98	61	27	9	1				314
31-35		12	16	9	3	5		1		43
36-40		3	3	3	3	4			2	18
41-45		1								1
Total	203	143	86	39	12	10		1	2	496

### Management of Abnormalities During Pregnancy

All serious abnormalities were referred for consultant advice, but in most cases the practical treatment of the case was carried out by the G.P. Two cases of anaemia required blood transfusion (Table II), but the remainder were successfully treated by the G.P. Fourteen of the cases of pre-eclampsia were transferred to consultant care, but 8 of the remaining 14 were induced by the G.P. and 6 received medical treatment; five of the latter delivered spontaneously and one was later transferred to the consultant with delay in the first stage of labour.

TABLE II.—Abnormalities Occurring During Pregnancy

Abnormality	No. of Cases	Management By		
		Consultant Staff	Consultant and G.P.	G.P. Alone
Anaemia (haemoglobin 10.3 g./100 ml. or less) ..	85	—	2 (transfusions)	83
Pre-eclamptic toxæmia ..	28	14	—	14
Antepartum hæmorrhage ..	7	3	4	—
Postmaturity ..	19	5	2	12
Persistent breech presentation	6	5	1	—
Non-engagement of head at 36th week ..	6	6	—	—
Pyelonephritis ..	5	1	—	4
Twin pregnancy ..	3	—	1	—
Positive Wassermann reaction	2	—	2	—
Intrauterine death ..	2	1	1	—
Premature rupture of membranes ..	1	—	—	1
Hydramnios (anencephalic)	1	1	—	—

All the cases of antepartum hæmorrhage were investigated by the consultant, but in four cases the patients were subsequently returned to the care of the G.P.

Twelve of the 19 cases of postmaturity were treated by the G.P., 11 of them being induced. Five cases were transferred to consultant care, and two more were induced by the registrar and returned to the care of the G.P.

Six cases of failure of the head to engage at the 36th week were identified by the G.P., and all were transferred to the consultant. Four cases of pyelonephritis were treated by the G.P., and one, with antepartum hæmorrhage as well, was transferred to the consultant.

Two immigrant women with positive Wassermann reactions were referred to the consultant venereologist, and remained under care of the G.P.

Two cases of twin pregnancy were diagnosed by the G.P. and transferred to the consultant at 30 weeks. A third case of twin pregnancy was cared for by the consultant and the very experienced G.P. throughout.

### Induction of Labour

Twenty-one inductions of labour were performed by the responsible G.P. (Table III). Postmaturity (11 cases) and pre-eclampsia (8 cases) formed the main indications.

TABLE III.—Induction of Labour Performed by G.P. 21 Cases

Indication for Induction	No. of Cases	Method of Induction	No. of Cases
Postmaturity ..	11	Low rupture of membranes (L.R.M.) ..	13
Pre-eclampsia ..	8	L.R.M. with pitocin infusion ..	3
Antepartum hæmorrhage ..	1	L.R.M. with buccal pitocin ..	4
Social reasons ..	1	Buccal pitocin alone ..	1

Induction/delivery interval: less than 24 hours in 18 cases, 24/48 hours in 3 cases.

### Management of Abnormalities During Labour

Co-operation between the G.P. and consultant, or registrar, was most evident in the management of abnormalities which occurred during labour. The more serious abnormalities were

transferred entirely to consultant care, but, as is shown, treatment in the remainder was carried out by the G.P., either alone or in co-operation with the consultant or his registrar.

It must be emphasized that even in cases recorded as managed by the G.P. alone the registrar had invariably been consulted beforehand and almost always was either present or in the near vicinity.

*Forceps deliveries* were performed in 33 cases (Table IV). Thirteen had previously been transferred to consultant care. In the remaining 20 the indications were foetal distress in four and delay in the second stage in 16. The occiput was posterior in three and deep transverse arrest developed in three. The registrar and G.P. co-operated in performing two midcavity forceps deliveries and in three cases where manual rotation was required before forceps delivery. In the remaining 15 cases low forceps delivery was performed under pudendal block by the G.P.

TABLE IV.—Complicated Deliveries

	Total	Consultant	Consultant and G.P.	G.P.
Forceps delivery ..	33	13	5	15
Breech delivery ..	5	3	—	2
Twin delivery ..	4	3	—	1
Vacuum extraction ..	5	5	—	—
Caesarean section ..	14	14	—	—
Postpartum hæmorrhage	9	4	—	5
Prolonged 1st stage ..	5	2	—	3
Premature labour ..	2	2	—	—
Prolapsed cord ..	2	1	—	1

Assisted breech delivery was performed in one primigravida and one multigravida by the G.P. Three further cases were delivered by the consultant staff.

*Twin deliveries* were performed by the G.P. in one case and by the consultant staff in the remaining three.

*Vacuum extraction* for delay in the first stage in primigravidae was used in five deliveries by the consultant staff.

*Prolongation of the first stage of labour* (more than 24 hours) occurred in five patients. Two were transferred to the consultant. Management of the remainder, including intravenous therapy, was by the G.P.

TABLE V.—Summary of 64 Cases Transferred Completely to Consultant Care

Principal Indication For Transfer	Outcome								Total	
	Spontaneous Vaginal Delivery	Delivery After Induction	Breech Delivery	Twin Delivery	Forceps Delivery	Vacuum Extraction	Caesarean Section	S.B.		N.N.D.
Pre-eclampsia ..		10		1	2		1			14
Postmaturity ..	1	4								5
Antepartum hæmorrhage ..						1	2			3
Primigravida: high head at 36th week					2		1			3
Suspected disproportion ..	1						1			2
Persistent breech presentation ..			2				2			4
Hydramnios ..		1						1		1
Twin pregnancy ..				2						2
Abdominal pain (interstitial pregnancy) ..							1		1	1
Unstable lie (suspected placenta prævia) ..							1			1
Premature labour ..	1	1							1	2
Social problems ..	2									2
Delay in 1st stage	2					4	2			8
Delay in 2nd stage					9					9
Prolapsed cord ..							1			1
Foetal distress ..					1		3			4
Intrauterine death	2							2		2

In addition, one patient was transferred during the third stage for postpartum hæmorrhage and three during the puerperium for sterilization.

*Prolapse of the cord* in one case was rapidly followed by delivery before any intervention was required. In the second case the patient was in the first stage and an emergency caesarean section was performed.

*Postpartum haemorrhage* occurred in three cases among the patients previously transferred to consultant care, and in six patients delivered under the supervision of the G.P.s. Five of these were successfully managed by the G.P., three requiring blood transfusion. In the sixth case the G.P. missed the delivery and the patient was transferred to consultant care.

Table V enumerates the cases transferred completely to consultant care, together with the main indication for their transfer and the ultimate outcome. It can be seen that even among patients carefully chosen as "low-risk cases" a substantial number of serious obstetric complications arose, involving 12% of patients booked (18% of primiparae and 7% of multiparae).

Complicated obstetric procedures were needed to deliver the majority of the patients transferred, only 25 of them being delivered spontaneously or after induction. In 15 cases caesarean section was performed.

### Infection

There were 23 cases of notifiable puerperal pyrexia, 7 being genital, 9 extragenital, and 7 undetermined. Infections, chiefly staphylococcal skin infections, occurred in 15 babies.

### Babies

Of the 500 deliveries, infection, chiefly staphylococcal skin infections, occurred in 15 cases. Bilirubin estimations were carried out on 18 babies. One baby had multiple congenital abnormalities, and another microcephaly due to cytomegalic virus infection. Fifteen premature babies were delivered, eight weighing over 5 lb. (2,270 g.), four weighing between 4 and 5 lb. (1,815 and 2,270 g.), one twin weighing 3½ lb. (1,590 g.), and two (detailed later) weighing 2 lb. (910 g.) or less.

Six babies gave cause for alarm:

(1) After a normal delivery one baby showed difficulty in maintaining respiration. Oxygen and Vandid (ethamivan) were administered, and the registrar carried out intubation. The baby was then transferred to the Belgrave Children's Hospital for 24 hours.

(2) The respiratory distress syndrome developed in one baby after delivery by lower segment caesarean section, and the child was transferred to King's College Hospital.

(3) A baby delivered by midcavity forceps, gasped, but then became apnoeic. Intubation and administration of oxygen under intermittent positive pressure was followed by the establishment of respiration after four minutes.

(4, 5, 6) Severe neonatal jaundice developed in three babies, who were transferred to King's College Hospital. Transfusion was required in two of them. All three mothers were rhesus-positive.

### Three Neonatal Deaths

(1) Recurrent abdominal pain developed in a primigravida at 28 weeks. She was referred for consultant opinion and admitted for observation. The attacks of pain continued, and internal haemorrhage followed. At laparotomy a sac containing an interstitial pregnancy was found. A 1 lb. 14 oz. (850 g.) baby of about 30 weeks' maturity was delivered, but lived for only 18 hours. The mother made a complete recovery.

(2) Premature labour at 24 weeks in a primigravida resulted in the assisted breech delivery of a 2-lb. (910-g.) baby who died shortly after birth.

(3) A female baby, weighing 6 lb. 3 oz. (2,810 g.), after a normal delivery at term remained cyanosed with respiratory difficulty despite resuscitation, including intubation. She was transferred to the care of the paediatrician, and x-ray examination showed

a tracheo-oesophageal fistula. Her condition gradually deteriorated, and she died aged 6 hours.

These are considered to be neonatal deaths with no avoidable factors.

### Three Stillbirths

(1) The patient, aged 36, had had five previous pregnancies. One child died at 3 months from bronchopneumonia, and the fourth pregnancy had been complicated by antepartum haemorrhage at term, resulting in a stillbirth. Despite advice from domiciliary midwives, from a clinic doctor, and from the G.P. she refused a hospital booking. Eventually she was persuaded to accept a "G.P. bed" booking, possibly with 48-hour discharge. The pregnancy progressed quite normally. Examination at 34 weeks showed a vertex presentation, the foetal heart was heard, the blood pressure was 130/80, and there was neither albuminuria nor oedema. The haemoglobin was 83%, the blood film was normal, and the patient was rhesus-positive with no antibodies detected at booking. The Wassermann reaction was negative. At 36 weeks the patient reported an absence of foetal movement for the previous 10 days. On examination the foetal heart was no longer audible. The patient eventually went into labour spontaneously and a macerated stillbirth was delivered.

(2) A patient aged 25, expecting her second baby, had a completely normal pregnancy. On the seventh day after the expected day of delivery she suffered a sharp attack of diarrhoea and vomiting. There was an epidemic of gastroenteritis in the neighbourhood at that time. Foetal movements were not heard after this, and when she went into labour the next day the foetal heart was inaudible. A fresh stillbirth was delivered.

(3) In this case an anencephalic foetus was delivered.

These are considered to be stillbirths with no avoidable factors.

### Attendance of G.P. at Delivery

The G.P. was present at 175 (40%) out of a possible 436 deliveries—that is, after excluding cases previously handed over to consultant care. As this represents actual attendance at the deliveries, and does not include many other instances when the G.P. was present during the first stage, or arrived shortly after the delivery, it is considered a "good effort," bearing in mind the difficulty bound to be experienced by the G.P. in attending cases delivered during surgery hours, and the difficulty faced by the hospital nursing staff in estimating the timing of the telephone call to the G.P. (This is borne out by the fact that the G.P. managed to get to the delivery in 63% of primigravidae.)

It was noticeable that doctors in partnership could attend a higher percentage of their deliveries than single-handed doctors.

### Length of Stay in Hospital

The majority of patients remained in hospital for 7 to 10 days. During the first year patients booked under the scheme were not allowed to have 48-hour discharge. The advantage in some cases of combining a booking under the scheme with 48-hour discharge became apparent and was allowed thereafter.

However, owing to difficulties experienced by the local authority and the ambulance service, the number of patients granted 48-hour discharge was severely limited, and in fact only 22 patients went home by arrangement after 48 hours, though five more patients took their own discharge.

There is no doubt that were the difficulties removed many women, especially multigravidae, would opt for discharge 48 hours after an uncomplicated delivery.

Three patients had sterilization performed after delivery and remained in hospital 11, 14, and 16 days respectively.

### The Scheme in Practice

Not unnaturally some difficulties arose in the working of the scheme. Some general practitioners found difficulty in understanding the conditions of their contracts; requests to book unsuitable patients were made; and sometimes when their presence was required at the hospital the G.P.s were difficult to find. Despite explanations, some patients found difficulty in understanding the scheme. The value of the G.P. "liaison officer" became apparent—in this case the honorary secretary of the Obstetric Society of South-east London—and most difficulties were sorted out quickly.

The hospital staff showed an understandable but unforeseen ignorance of the way G.P.s organize their lives, and much time was wasted trying to contact a doctor personally by telephone, when a message left with a deputy was all that was required.

Initially 80 G.P.s applied for the opportunity to use beds. Eventually only 25 doctors in 14 practices made use of the scheme. For the staffs of the two hospitals to get to know 25 G.P.s took as long as for the G.P.s to get to know the staffs of the hospitals, but the situation was eased by the fact that bookings were limited to seven per month at each hospital for the first few months. The number was later increased to 10, and finally increased to "at the discretion of the consultant." In fact, equilibrium seems now to have been established, since the number of cases fulfilling the booking criteria is limited. The numbers vary from month to month, but between 70 and 100 cases seem to be booked annually at each hospital. The patients most certainly like the scheme, especially when associated with 48-hour discharge. Indeed, it has been found possible to persuade some grand-multiparous patients or patients with an abnormal obstetric history who have refused hospital confinement to accept confinement under this scheme as an alternative to confinement at home.

A most interesting development of the scheme, not envisaged originally, has been the admission of district emergencies to G.P. beds. Two examples of this may be of interest.

(1) The patient booked for home confinement. The membranes ruptured at term, but contractions did not ensue. Twenty-four hours later, after consultation with the registrar, the patient was transferred to hospital. There the G.P. administered an intravenous Syntocinon (oxytocin injection) infusion. A normal vaginal delivery ensued, and mother and baby returned home 24 hours later.

(2) This patient booked for home confinement. The first stage of pregnancy was normal. Delay developed in the second stage of labour owing to deep transverse arrest of the head. There was no foetal distress. She was transferred to the labour ward of the consultant unit by ambulance. Manual rotation and forceps delivery was carried out by the G.P. under the supervision of the registrar. Mother and baby returned home after 36 hours in hospital.

### Comment

We would be the first to agree that no firm conclusions can be drawn from the results of only 500 cases. Nevertheless, we would emphasize that the perinatal mortality reported relates to all cases booked for G.P. care, irrespective of whether transfer to the consultant took place eventually. It has been shown (Hobbs and Acheson, 1966a) that the perinatal mortality in such cases may be as high as 82 per 1,000, and it is felt that the initial care by the G.P. may have some bearing on the ultimate outcome.

Under these circumstances we feel that a perinatal mortality of 12 per 1,000 is an encouraging result. It would seem that this is a scheme offering a wide margin of safety to both mother and baby.

Bearing in mind that abnormalities necessitating transfer to consultant care arose in 12% of these low-risk cases, and transfer to hospital would have been necessary for half as many

again had they been booked at home, it is felt that home confinement does not offer an adequate alternative.

### Discussion

The problem faced by the G.P. practising domiciliary obstetrics in large towns and cities is that, with good selection of cases and immediate transfer to hospital of those with warning signs, he will see few abnormalities. The majority of these can be transferred rapidly to hospital and there be dealt with more safely than at home.

Thus the longer he practises the less practised he becomes, and is ill equipped to deal with the sudden emergency requiring immediate intervention. But it is in just this type of case that the possibility exists of reducing still further the already low maternal and perinatal mortality. Successive confidential reports on maternal mortality and the perinatal mortality survey of Butler and Bonham (1963) have underlined the problem. Hobbs and Acheson (1966b) pointed out that, given the selection of cases that should take place, it is not enough for G.P.s' results to equal those of consultant units; they should be better.

The problem is, then, "How can the G.P. continue in obstetrics, maintain his skill, although seeing few cases, produce results not only better than the national average but better than the hospitals, and at the same time make immediate expert help available to his patients who need it?"

One solution suggested is improved flying-squad facilities. In urban areas, where the distance from the hospital is never great, the temporary disappearance of several members of the hospital staff for an indeterminate time may leave dangerous gaps in the service available at the hospital, and it is difficult to see how any flying squad could equal the facilities of the hospital. Possibly this solution is satisfactory in country districts, though if the argument is that the home is too far away for hospital confinement to be convenient it is also arguable that the hospital is too far away for home confinement to be safe.

G.P. units may be safer than the patients' homes, but in an area already well endowed with consultant units it is difficult to see how they could ever be other than poor relations, both in physical facilities and in obstetric expertise. Where G.P. units do not already exist the problems of land, building, staffing, and equipping arise. Finance will not be forthcoming unless results can be shown to be much better than those in hospitals.

Delivery units seem a better solution, but if the G.P. is integrated that much why segregate at all?

Many believe that all confinements should take place in hospital under specialist control. At the present time a shortage of beds and medical staff in hospitals makes this impossible. The advantages of the scheme outlined are considerable for patients, consultant, and G.P.

The mother and baby have the advantage of personal care, continuing after delivery and discharge from hospital, by their family doctor. At the same time the full facilities of a consultant obstetric unit are immediately available should an abnormality arise.

The consultant retains overall control of the patient, and adds to his hospital team a number of experienced practitioners to deal with straightforward cases. Complicated cases can be quickly transferred without "loss of face" to the consultant or registrar, as appropriate.

The G.P. is enabled to practise obstetrics in the best surroundings, and is able to deal with abnormalities to the limit of his skill and experience. No longer is it a choice between heroic obstetrics in the home and complete relinquishment of responsibility (nor between emigration and the U.K.). He becomes a member of the hospital team, and his liaison extends

to all levels, from the inquiring medical student or pupil midwife to the registrar and consultant.

In addition, the postgraduate education of the G.P. is a continuous by-product of the scheme. If the difficulties existing in transporting patients home and getting them looked after by domiciliary midwives after early discharge can be overcome wide adoption of the scheme within a particular area, in conjunction with 48-hour discharge, could lead to a high rate of hospital confinement, and a more uniform standard of obstetric care than can be attained at present. And this is without loss of consultant control on the one hand or valuable general-practitioner obstetric services on the other.

If the G.P. is to have a future in obstetrics, certainly in urban communities, he must be able to deliver his patients in a fully equipped maternity hospital. The present scheme allows him to do this and at the same time play a vital part in the work of the consultant unit.

Future developments of this and similar schemes should be aimed at ending the present antiquated tripartite system and unifying district obstetric facilities, including general practitioners and domiciliary midwives, into a single service based on the hospital consultant team.

We wish to thank Mr. Basil Sanderson, consultant obstetrician to St. Giles Hospital, who initiated this scheme, and Lady Joyce Burt for their permission to publish details of those patients delivered under their care. We are especially grateful for the enthusiasm of the general-practitioner obstetricians in the area which was essential for the survival of the scheme; the fact that it has done so is a tribute to them. Our thanks are also due to the registrars, Mr. B. B. Obeng and Mr. S. N. Morcos at St. Giles, and Mr. J. Ritchie, Mr. E. Platts, and Miss G. M. Roberts at Dulwich, whose helpful co-operation with the G.P.s contributed in great measure to the success of the scheme. Without the help received from the nursing and clerical staffs of the hospitals, in particular Miss D. Kidd, maternity superintendent at St. Giles, and Miss K. Shaw, maternity superintendent at Dulwich, the scheme would never have survived its teething troubles, and to all of them we are most grateful.

#### REFERENCES

- Butler, N. R., and Bonham, D. G. (1963). *Perinatal Mortality*. First Report of the 1958 British Perinatal Mortality Survey. London.  
Hobbs, M. S. T., and Acheson, E. D. (1966a). *Brit. med. J.*, 1, 499.  
Hobbs, M. S. T., and Acheson, E. D. (1966b). *Lancet*, 1, 761.  
Oldershaw, K. L. (1965). *Brit. med. J.*, 2, 1551.

## MEDICINE AND THE COMPUTER

### III—Record Linkage\*

[FROM A SPECIAL CORRESPONDENT]

Many epidemiological studies of the causes of chronic diseases involve the assessment of the roles of heredity, occupation, and previous illnesses. But at present this is difficult, because this information is scattered in the records of so many different departments and authorities. One of the ways of solving this problem is to hold all medical information about a population as a system of linked records, containing not only details about a person's medical and occupational history from birth to death, but also about his parents and family as well.

In 1962 the Oxford Record Linkage Study was started as a pilot scheme, and this now covers a large part of the Oxford region, with a total population of almost  $\frac{3}{4}$  million. A year later the decision was taken to try to replace the conventional method of processing the data—which was rapidly becoming overwhelmed by the sheer mass of facts—by computer processing. Work continues on the development of this system, but a workable system of record matching has been started and certain analyses for medical research and administration carried out.

#### Collecting the Data

One of the most important decisions was which medical events should be recorded about each person. To get the system working properly it was decided to start with just a few key facts—birth, discharge from hospital, confinement, and death. Data about these events are abstracted by the Study's team from various sources—birth and death certificates, discharge summaries in hospital case notes, and from domiciliary obstetric records. But, even to get just these data rendered into a form suitable for the computer has proved to be one of the most time-consuming, difficult, and expensive operations in the whole study.

Data obtained in this way are coded and punched into cards at the headquarters of the Linkage Study in Oxford. Two

\* Part I, "Managing a County Health Service," was printed in the issue of 29 June (p. 823). Part II, "Running a Mental Health Service," appeared last week (p. 51).

cards are punched for each event—an identification or names card, and a statistics card containing diagnostic and administrative information. It is the first of these—the names card—which provides the link enabling any details to be added to the rest of a person's record. Successful linkage of this kind means that records must contain sufficient identifying data to differentiate that person's records from those of all the other people in the study. Obviously the larger the population concerned the more identifying data will be needed, and at Oxford it has been decided to record the full names, part of the address, maiden name, and date and place of birth. The N.H.S. number is also recorded when available, but unfortunately at present this is known to only a minority of the population.

#### Computer Linkage

A big problem in record linkage is caused by changes, omissions, and discrepancies in the identification data. People change their names and addresses, and tend to give different personal details on successive occasions. Using a manual card index system a clerk will use his own judgement whether a given new record relates to the same person as a given index card despite these discrepancies. To be successful any linkage system must also aim to do the same, and this can be done by programming the computer to make successful matching judgements.

The medical records are kept on a master magnetic tape file, and they are arranged in surname order, according to Soundex code—a phonetic version of the alphabet. By this system similar sounding surnames are grouped into Soundex blocks to allow the matching of records in which the surnames have been misspelt. One such block, for example, contains the names Adkins, Aitkins, Atkinson, and others. Within the Soundex block the records are further sorted by sex and first initial of forename.

Data from the incoming new event cards are transferred by the computer to magnetic tape, and are then sorted into the