

Advances in acute coronary care

Part 2

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Bristol

The mobile coronary care unit in Belfast

THE pioneer mobile cardiac ambulance designed by Drs Pantridge and Geddes, is centred on the cardiac unit of the Royal Victoria Hospital, Belfast.

The inpatient intensive care unit consists of eight single cubicles—situated in the centre of two communicating wards. Each cubicle is equipped for continuous monitoring of the patient, both at the bedside and also on an eight channel central monitor in the nursing station. Oxygen and suction are in each cubicle, and a mobile defibrillator on a trolley ready for immediate use.

The staff of the ward consists of one senior and one junior consultant physician, two senior research registrars, two registrars and four residents (two SHO's and two HP's). The ward is in the charge of a sister and a number of staff nurses. Six medical students are attached to the unit for their period of medical clerking, and take an active part in the care of the patients.

Emergency calls for the cardiac ambulance have priority over all other calls on the hospital switchboard, and are taken on the ward by sister, or a senior member of her staff on a special telephone. A special telephone number is allocated to the cardiac ambulance unit, and by this means general practitioners, first aid workers and patients obtain immediate and direct access to the ward, without going through the hospital switchboard. This number is given to the major stores and firms in the city, and general practitioners are encouraged to reveal this number to any patient whom they consider to be at special risk. These patients are instructed to contact the unit direct, should they have an episode of cardiac pain lasting longer than 15–20 minutes, particularly if accompanied by any other symptoms suggestive of an infarct.

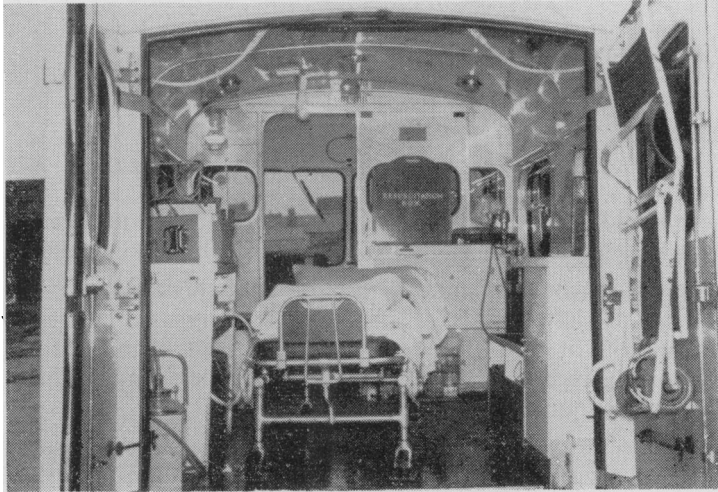
The cardiac ambulance is stationed at the ambulance depot 250 yards from the hospital, where a driver is always on duty, and no special driver needs to be allocated to the cardiac ambulance. The first and second call medical residents, one staff nurse and the duty medical student are equipped with 'bleepers'. As soon as a call is received and accepted, the team run to the nearby car park where the ambulance is ready and waiting for the team's arrival.

Once in the ambulance the student prepares the ECG terminal plates and the medical officer 'warms' the portable oscilloscope. Direct contact is maintained with the ward by a radio telephone handset. Drugs are carried already drawn up in disposable syringes.

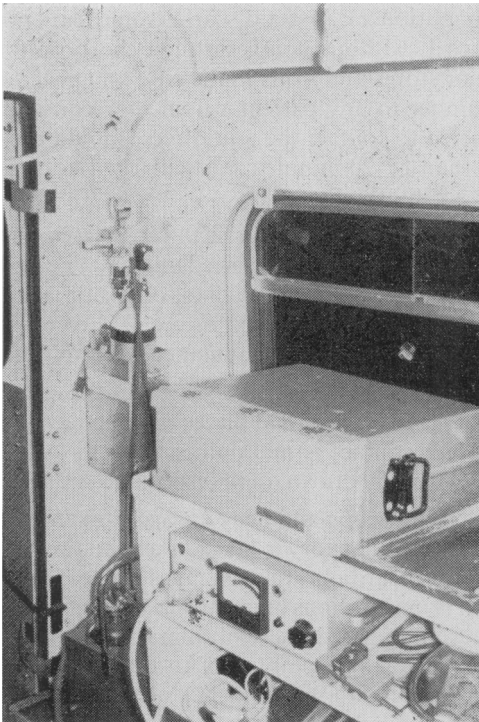
On arrival at the patient's house the ECG oscilloscope and drug case are taken into the house. The ECG is attached to the patient, while the history is being taken, and within two or three minutes the rhythm is known, the electrocardiographic changes observed and the necessary treatment instituted. If the patient is unconscious or in cardiac arrest, needle electrodes for the ECG are used instead of plates and immediate defibrillation performed by a portable battery charged defibrillator. Dr Pantridge points out to the team, that once the patient is under constant ECG monitoring, there is no further need for hurry. Anti-arrhythmic treatment by drugs, DC shock or artificial pacemaker can be used in the

patient's home, and the patient can be kept at home until fit to be moved, the ambulance proceeding slowly to the hospital, if necessary stopping while further injections are given.

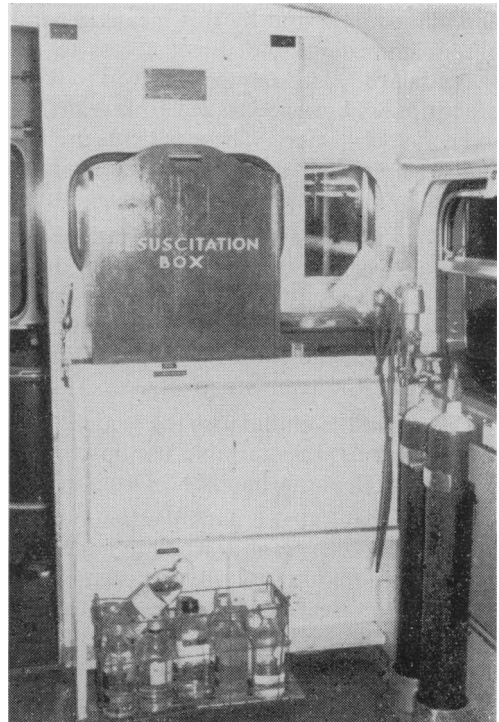
All live patients attended by the ambulance are admitted to hospital, even if there



The interior of the ambulance, showing particularly the centrally positioned bed stretcher. Spotlight in the roof. Bench seating for members of the mobile team. Mechanical sucker and defibrillator on the left. Resuscitation box, oxygen and intravenous fluids on the right. Case containing drugs already drawn up in labelled disposable syringes is not shown.



The portable battery charged defibrillator.



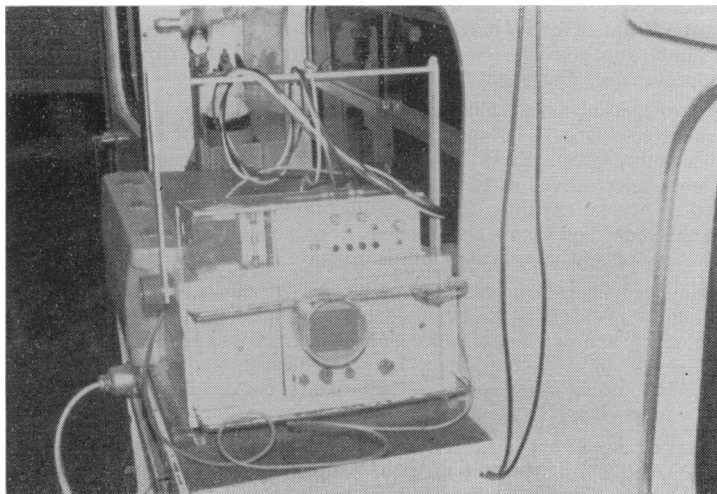
The resuscitation box containing an Ambu bag, airways, endotracheal tubes, etc.

is doubt as to whether the patient has had an infarct. Patients are not moved from home until:

1. the circulation as judged by BP and peripheral circulation is satisfactory
2. the cardiac rhythm is stable
3. severe pain has been relieved.

"There is never any point in rushing the very ill patient to hospital—hospital has nothing to offer which cannot be provided at home, and, further, the journey will kill the patient".—(JFP).

During the three-year period 1966–1969, 794 patients with indisputable acute myocardial infarction were admitted to the coronary care unit. During this time 126



The portable battery operated electrocardiograph and oscilloscope.

patients with cardiac arrest occurring outside hospital were encountered. In 71 of these patients, no resuscitative measures had been initiated within four minutes. Fifty-eight patients developed asystole and 13 ventricular fibrillation. All died.

In 55 patients resuscitation was commenced within four minutes, but in 22 patients it was inefficient. In spite of this, 11 patients survived. The remaining 33 patients had efficient resuscitative measures instituted within four minutes of their collapse. Only three of these patients had asystole, 30 had ventricular fibrillation, and 28 patients survived.

These figures demonstrate first that it is possible to resuscitate patients with cardiac arrest efficiently outside hospital, and that if immediate efficient help is available the results compare favourably with results obtained in inpatient intensive care units. Second, that some patients may survive even with inefficient resuscitation, provided that defibrillation can be undertaken within a short space of time.

More important is the long-term follow-up of these patients. Twenty-seven patients (including three young people, 14, 16 and 24 years respectively who had cardiac arrest outside hospital, from causes other than myocardial infarction), were resuscitated successfully by the team, and survived long enough to be discharged from hospital. All the others were between 40 and 70 years of age.

| | | | | | |
|--------------------------|----|----|-------|----|------------|
| <i>Age distribution:</i> | .. | .. | 40–49 | .. | 9 patients |
| | | | 50–59 | .. | 7 patients |
| | | | 60–69 | .. | 8 patients |

The clinical severity of the infarct in 19 of these patients was classed as mild, the remaining eight moderate.

The longest survival time recorded to date has been 28 months. Thirteen patients were already back at work, a further six had reached the stage of convalescence at home.

It thus appears that in Belfast, the mobile coronary care unit has saved lives which would otherwise have been lost, and this particularly among the young and middle-aged patients whose infarcts were not severe, many of whom have survived to resume normal active work.

Brief case notes of patients seen during the week spent in Belfast illustrate some of these points.

Case 1. Woman, aged 47 years, history of angina of effort for some weeks. Acute central chest pain came on in bed at 5.30 am. General practitioner called at 5.45. General practitioner arrived and called cardiac ambulance at 6 am. Patient shocked blood pressure 90/?. Cardiac arrest due to ventricular fibrillation at 6.10 am. General practitioner gave external cardiac massage and artificial respiration. 6.15 am. cardiac ambulance arrived—six shocks given, reverted to sinus rhythm. Blood pressure rose to 110/80, rapid improvement, discharged from hospital.

Case 2. Man, aged 67 years, collapsed in church at 11.45 am. given external cardiac massage and mouth-to-mouth respiration by a nurse present in church within one minute of arrest. Ambulance called (not cardiac ambulance), arrived 12.5 pm. ambulance attendants took over external cardiac massage. Cardiac ambulance arrived at 12.10 pm. ECG showed ventricular fibrillation, treated with DC shock. Reverted to normal rhythm. Remained unconscious for several days with signs of cerebral oedema, but by the sixth day was much improved, conscious and responsive. Life was sustained by external cardiac massage and mouth-to-mouth respiration for 25 minutes.

Case 3. Man, aged 43 years, a priest, had had increasing cardiac effort pain for one week. Severe chest pain for 15 minutes while in bed at home. Given heroin intravenously he felt better. Ten minutes later, while being transferred to the ambulance he became unconscious with ventricular fibrillation. He responded to DC shock, but 20 minutes later further defibrillation was necessary for recurrent ventricular fibrillation. His future progress was satisfactory—ECG showed an antero-septal infarction, and when seen in his second week he was making a good recovery.

Case 4. Spinster, aged 65 years, had sudden onset of cardiac ischaemic pain—no antecedent angina. Two-and-a-half hours after the onset of pain she was brought to casualty by the ordinary ambulance. While an ECG was being recorded in casualty she had ventricular fibrillation. DC shock after external cardiac massage produced asystole, but this reverted to normal rhythm after a vigorous thump on chest. She made uneventful recovery. If this patient had been admitted by cardiac ambulance, she would not have been taken into the casualty department, but would have been under intensive care throughout the preceding three quarters of an hour.

Case 5. Man, aged 56 years, had suffered from multiple sclerosis for 20 years but was ambulant. Episode of cardiac pain, sweating and shock for preceding three hours. General practitioner contacted cardiac ambulance in view of bradycardia. Pulse rate 50. Requested to give intravenous atropine (morphine already given). Patient reached in 10–15 minutes from call. Pulse 90, blood pressure 130/90. Multiple extrasystoles—given lignocaine 100 mg before moving to ambulance. During journey further multiple extrasystoles occurred. Ambulance stopped, 50mg lignocaine iv given (together with oxygen). After admission this patient developed atrial fibrillation, producing shock and cardiac failure. He was given iv digoxin but developed ventricular tachycardia, and later two episodes of ventricular fibrillation which were treated by DC shock. He reverted to normal rhythm.

This man was admitted by the second call team, using a normal ambulance, but carrying the reserve ECG oscilloscope and defibrillator, the cardiac ambulance already being used for another patient.

A number of other patients with myocardial infarction or suspected infarction were admitted uneventfully by the ambulance, under constant monitoring by ECG, during my time with the unit.

Suggested reasons for the success of the Belfast mobile team

1. In a city of 500,000 people, 100,000 live within the radius of a mile of the hospital.
2. The close proximity of the central ambulance station with its experienced drivers who know the city well, means there is no delay in bringing the team into action.
3. The extensive publicity programme which has been directed not only to the general public, but also to the management of large stores and works in the city.
4. Intensive and extensive training courses for general practitioners, nurses, and

first aid workers in the city, in the techniques of external cardiac massage, and mouth-to-mouth respiration.

5. The co-operation of the general practitioners who are encouraged to send for the mobile team—when they receive a call from a patient suspected of having an infarct—even before they leave home.

6. The relative absence of severe traffic problems in Belfast and the complete priority given to the unit by drivers.

7. The availability of a relatively large number of young, enthusiastic residents, nurses and the active involvement of the medical students attached to Dr Pantridge's firm.

8. The continued enthusiasm and driving force of the senior consultant and his colleagues, together with the continuous reappraisal of the methods of treatment used by the unit.

The Newcastle upon Tyne mobile cardiac ambulance

The mobile unit at Newcastle upon Tyne was initiated by Dr H. A. Dewar of the cardiological department at the Royal Victoria Infirmary. Essentially it is similar to the Belfast unit in construction and equipment.

Newcastle upon Tyne has a population of 300,000. In a three month survey 213 deaths were certified as being due to ischaemic heart disease. Of these, 62 per cent died outside hospital, 38 per cent died in hospital. Of those dying outside hospital, no less than 68 per cent died within a few minutes, or were found dead. Eighteen per cent were elderly patients who died from heart failure, secondary to ischaemic heart disease, and only 14 per cent had a classical story of chest pain of 30 minutes duration or more.

During the first eight months, 100 calls were made on the ambulance—an average of three per week. An assessment was made by the medical officer who went in the ambulance, of its value in each individual case. It was considered that:

- 2 lives were definitely saved
- 13 patients were substantially improved
- 12 appreciably improved
- 7 were dead before arrival
- 7 died in the home in spite of treatment
- 59 were considered not to have benefitted to any material degree.

Unfortunately a number of factors handicap the Newcastle team. The ambulance station is situated one mile away from the hospital and there is a significant delay in picking up the medical team from the hospital. This probably averages at least five minutes.

There is a shortage of both medical and nursing staff to man the ambulance. Apart from the consultant, the resident staff comprise one senior registrar, two senior house officers and two house physicians. There are a limited number of trained staff nurses on the ward and the loss of these nurses after they have been fully trained in intensive care is high.

The organization of the Newcastle medical school means that students cannot take an active part in the project. In addition, Newcastle has two major hospitals offering intensive care facilities for myocardial infarction.

Various methods have been tried to reduce the delay in getting an ambulance. Medical officers have driven the ambulance—but this has two disadvantages, first that

they do not know the roads so well as the regular ambulance staff and, secondly, not all the medical officers feel competent to handle an ambulance, particularly in an emergency. It is necessary for the ambulance service to send a second driver to the incident, by some independent means, to bring the patient back to hospital, while the medical officer supervises the intensive care. For these reasons this method has now been abandoned.

The two hospitals provide medical officers for the cardiac ambulance on a rotating basis, and medical officers working in other departments of the medical school, have taken part in the project.

So far only 45 per cent of the general practitioners of Newcastle have used the service. This together with the extensive employment of an emergency treatment service in Newcastle, has resulted in uneven use of the cardiac ambulance by doctors. Finally, Newcastle has more severe traffic problems, with a complicated one-way system, which contributes to the delay in bringing the team to the patient. There still remain the two major problems of high immediate death rate, and delay in the patient seeking medical advice.

On the other hand the Newcastle team report that their help has been requested in a number of acute cardiac emergencies, other than myocardial infarction, *e.g.* acute pulmonary oedema and paroxysmal tachycardia. It was felt that in the majority of these cases, effective and valuable help had been given to the patient by the mobile team. The full details of organization of the Newcastle Emergency Cardiac Resuscitation Unit have recently been published in the *British Medical Journal*.

The Edinburgh community study

During the past year an intensive survey of cases of acute myocardial infarction in Edinburgh has been organized by Dr Oliver and Dr Julian from the cardiac department of the Edinburgh Royal Infirmary, in conjunction with general practitioners and the ambulance service. The aims of the study included a detailed breakdown of the time interval elapsing between the onset of symptoms of an infarct, and arrival in the intensive care unit.

The median interval between onset and arrival in the intensive care unit in 1,300 cases was 4 hours 47 minutes (excluding cases who were admitted later than 48 hours after onset). The most useful and reliable figures were obtained from cases of myocardial infarction or suspected myocardial infarction admitted to the intensive care unit.

Interval from

| | |
|--|---------------------------|
| Onset of symptoms to calling general practitioner .. | 1 hour 44 minutes |
| Calling general practitioner to general practitioner arrival at house | 51 minutes |
| General practitioner arrival to call to bed bureau .. | 33 minutes |
| Bed bureau to calling ambulance service | 10 minutes |
| Calling ambulance to arrival of ambulance at house .. | 20 minutes |
| Arrival at house to arrival of ambulance at hospital .. | 21 minutes |
| Arrival of ambulance at hospital to admission to ward | 29 minutes |
| TOTAL | 4 hours 28 minutes |

These figures, with those of Pemberton from Belfast, suggest that more than 30 per cent of the delay in getting patients to hospital is due to failure by the relatives to recognize the urgent need to call the doctor. A further 25 per cent of the time passes before the arrival of the general practitioner.

Three factors appear to operate in patient delay:

1. Severity of the prevailing symptoms
2. Previous experience of myocardial infarction
3. Time of day or night

Patients are remarkably stoical, and often wait for several hours rather than call their doctor during the night. One of my own patients developed symptoms of a myocardial infarction with dyspnoea from pulmonary oedema at 2 a.m. one morning, yet did not send for me until 8 a.m. She felt unwilling to disturb me during the night.

Three factors also appear to affect the delay in arrival of the general practitioner:

1. The availability of the general practitioner at the time the relatives call—particularly if he is out on his rounds
2. The general practitioner's knowledge of the patient's previous history
3. The content and urgency of the message as received by the general practitioner.

Possible means by which delay in onset-admission time could be reduced would seem to be:

The careful instruction of all patients at risk, particularly those suffering from angina, of the need to contact the doctor should they experience acute central chest pain lasting longer than 20 minutes particularly if accompanied by other signs suggestive of an infarct.

The training of all industrial nurses and first aid workers in the techniques of external cardiac massage and mouth-to-mouth resuscitation. Regular opportunities must be provided for practice on a manikin as it has been shown that this art is quickly lost unless it is regularly practised.

Improvement in organization of the general-practitioner service particularly in wider use of radio telephones—(this matter is intimately related to finance).

Possibility of initiating the call to the ambulance service more quickly, particularly in cases in which diagnosis is straightforward. This again depends on the presence of a telephone. One can hardly leave a patient incompletely examined, without treatment, or in severe pain—to go to a public call box.

Delay in the time between arrival at the hospital and admission to the ward should be easily reduced by direct admission to the intensive care unit without using any intervening hospital department.

The principal delay still occurs in the time between the onset of pain and the patient summoning the doctor, and until this is reduced the value of establishing a mobile service in Edinburgh is regarded as doubtful. General practitioners are encouraged to admit patients suffering from a myocardial infarction to the intensive care unit as rapidly as possible.

Study of deaths from myocardial infarction occurring in a Bristol practice

I have attempted to trace all deaths occurring as a result of myocardial infarction in the practice conducted by my partner and myself over the three-year period 1966–1969, by detailed examination of the records held by the executive council.

During the period studied 33 deaths were recorded as being due to acute myocardial infarction—the majority of the diagnoses in cases of sudden death are supported by post mortem examinations. Patients suffering and dying from the late results of myocardial infarction, *e.g.*, congestive heart failure have been excluded.

In the period studied 24 men and nine women died.

The age-sex distribution was:

| <i>Age</i> | <i>Men</i> | <i>Women</i> |
|------------|------------|--------------|
| 41 — 50 | 1 | 0 |
| 51 — 60 | 4 | 1 |
| 61 — 70 | 8 | 2 |
| 71 — 80 | 10 | 3 |
| 80 + | 1 | 3 |

Deaths divided by location, *i.e.*, place at which deaths occurred.

| | <i>Men</i> | <i>Women</i> |
|---|------------|--------------|
| 1. Found dead at home | 2 | 1 |
| 2. Collapsed in the street/garden, public library, etc. | 7 | 4 |
| 3. Clinical myocardial infarction died at home .. | 9 | 1 |
| 4. Clinical myocardial infarction died in hospital .. | 5 | 2 |
| 5. Place unknown.. .. . | 2 | 0 |

Sudden deaths accounted for one-third of all deaths, *i.e.*, 11 out of 33.

1. Man 65 Collapsed and died in street—no resuscitation
2. Woman 60 Collapsed and died immediately at home—no resuscitation
3. Woman 64 Collapsed and died in garden—diabetic—no resuscitation
4. Man 68 Collapsed and died in surgery while being examined (known to have extensive arterial disease)—external cardiac massage, etc. no response
5. Woman 75 Collapsed and died at home—no resuscitation (known to have had ischaemic heart disease for five years)
6. Man 79 Collapsed and died at home
7. Man 75 A fit active man who collapsed and died in the public library—no resuscitation
8. Woman 68 Collapsed and died while walking on the beach at Weston (known to have severe hypertension)
9. Man 65 A patient who had ischaemic heart disease for at least four years—was found collapsed and apparently dead in his garden—dead when I arrived at house within three minutes of call
10. Man 55 Collapsed and died in the street
11. Man 53 Clinical myocardial infarction—died suddenly while being examined by my partner

These figures reflect the common experience of any one individual general practitioner. Many of the patients are elderly, or are known to have extensive vascular disease, or complicating conditions such as diabetes mellitus. Myocardial infarction simply represents a terminal event in the natural history of their condition. However, there remain a small number of young, active patients who collapse and die either at home, or in some public place and for whom the resuscitative expertise offered by a mobile intensive care unit, might well have been life saving.

Conclusions

The mobile intensive care units have demonstrated convincingly that cardiac resuscitation outside hospital is a practical proposition.

The speed with which patients are brought under intensive care remains the crucial factor in success or failure.

Geographical considerations and traffic problems will inevitably limit the development of such units in many places.

Where conditions are favourable, the cardiac ambulance represents a major advance, and this offers the patient the best chance of survival. It is particularly significant that no patients have died, outside hospital, from ventricular fibrillation, once they have come under the care of the Belfast mobile team.

Whether mobile care is available or not, all studies show that avoidable delays occur before treatment is instituted.

Patients at risk require clear instruction in the need to summon medical aid for any central chest pain not relieved by rest, and lasting longer than 20 minutes.

There are major differences of opinion as to the wisdom of admitting all patients for intensive care.

A study is in progress in Bristol and other West Country centres to compare the results of home and hospital treatment. The results from this study will not be available for at least another year.

At present 60 per cent of the deaths from myocardial infarction still occur outside hospital, and until mobile intensive care is more widely available, the problem remains one for the general practitioner.

The timely use of lignocaine, atropine, steroids, oxygen and external cardiac massage may well reduce the existing high mortality rate from this disease.

Acknowledgements

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Psychiatric illness in general practice. A detailed study using a new method of case identification.

D. P. GOLDBERG, M.R.C.P., D.P.M., and B. BLACKWELL, M.D., D.P.M. *British Medical Journal*. 1970. **2**, 439.

A general practitioner who was also a psychiatrist and a consultant psychiatrist showed a high degree of correlation in the assessment of 200 patients seen by both. There was, however, a considerable hidden psychiatric morbidity in that one third of the cases assessed as disturbed by the psychiatrist were missed by the general practitioner, who was a trained psychiatrist and orientated toward the detection of emotional illness. Most of these patients had presented originally with somatic complaints.

Five hundred and thirty three consecutive patients attending the general practitioner's surgery (including the 200 above) were also assessed by a self-administered questionnaire—the General Health Questionnaire. Over 90 per cent were correctly classified as 'well' or 'ill' by this.

General practitioners in hospital. J. WESTON SMITH, M.B., D.R.C.O.G., M.R.C.G.P., and J. B. O'DONOVAN, M.B., B.S., M.R.C.G.P. *British Medical Journal*. 1970. **2, 653.**

Tamworth General Hospital has 68 beds and is run by local general practitioners without resident staff. In addition to medical cases and minor surgery, a limited spectrum of major surgery is undertaken—such as hysterectomies, prostatectomy, mastectomy and some major orthopaedic operations. Inpatient costs per week were only £37 15s. 6d. (£37.77) as opposed to £51 15s. 0d. (£51.75) in the Birmingham Regional Acute Hospital. Eleven of the local general practitioners operate a casualty rota and trauma clinics are held twice weekly by visiting orthopaedic surgeons. Careful selection of cases is vital to the smooth running of the hospital without resident medical staff.

In 1854 Dr Thomson of Tamworth was the first doctor to point out the advantages of village (or cottage) hospitals—a concept that subsequently spread over the whole of Britain.