

Benefits to a regional neurosurgical unit following the introduction of a decentralised imaging facility

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Objective. To determine whether the establishment of a peripheral computed tomography (CT) facility has an influence on the central referral neurosurgical unit, and particularly whether unnecessary referrals are avoided.

Design. The outpatient records of all patients referred from Umtata General Hospital (UGH) to the neurosurgical unit at Wentworth Hospital, Durban, were retrospectively analysed over a 4-year period — 2 years before and 2 after the introduction of CT facilities at UGH.

Setting. Wentworth Hospital, Durban, which houses the sole neurosurgical referral centre for the region.

Patients. Eight hundred and forty patients were referred to the neurosurgical unit from UGH during the 4-year study period — July 1990 to June 1994.

Main outcome measures. 1. The number of referrals to the neurosurgical unit before and after introduction of peripheral CT facilities at UGH.

2. The admission rate of the above referrals during the same periods, indicating appropriate referrals.

Results. 1. There were 536 patients referred from UGH to the neurosurgical unit over a 2-year period before the introduction of peripheral CT facilities, and 304 patients during the subsequent 2-year period after introduction of CT facilities at UGH. This represented a 43.3% decrease in patient referrals during a period in which referrals from all other areas increased by 2.6%.

2. The admission rate of patients (indicating appropriate referrals) being referred from UGH increased from 46.3% before CT facilities to 79.9% after the introduction of peripheral CT facilities. The admission rate of patients from other areas, excluding UGH, during the same periods, decreased from 50.3% to 46.4%.

Conclusion. This audit reveals that following the introduction of CT facilities at UGH, the number of

referrals to Wentworth Hospital's neurosurgical unit decreased by almost half (43.3%). Furthermore, the patients referred after introduction of the peripheral CT facility were more likely to be appropriate referrals (79.9%) than before (46.4%). Therefore, the provision of CT facilities at peripheral hospitals may effectively serve to exclude those patients who would otherwise be referred unnecessarily, and enable earlier referral of those patients who require urgent care at a tertiary neurosurgical unit.

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Because of constraints on the health care budget in South Africa, judicious allocation of expensive resources, such as computed tomography (CT) facilities, is necessary. However, this must be balanced against the need to decentralise health care services in order to make them more accessible. When CT scanning capabilities at peripheral hospitals are considered, the demand to provide a facility must be weighed against the need.

Umtata General Hospital (UGH) is a distant, large, busy general hospital which refers patients who may require neurosurgical care to the centralised tertiary neurosurgical unit at Wentworth Hospital in Durban. CT facilities were introduced for the first time at UGH in June 1992.

We studied the impact of these new CT facilities at UGH on patterns of patient referral and admission to the tertiary neurosurgical service in Durban.¹

Patients and methods

Tertiary neurosurgical services in Durban are the sole public sector referral centre for the communities of KwaZulu-Natal, Swaziland and parts of the Eastern Cape, the limits of the catchment area being determined mainly by physical factors such as distance and geographical factors and, less so, by political boundaries. The Wentworth neurosurgical service serves a population of about 9 million people.

CT facilities were introduced at UGH in June 1992. The referrals from UGH were analysed retrospectively in the 2 years (July 1990 to June 1992) preceding, and the 2 years (July 1992 to June 1994) following, the introduction of CT services at UGH. The admission rate was used to indicate the number of 'appropriate referrals'. This was determined as follows:

$$\frac{\text{number of admissions}}{\text{number of referrals}} \times 100.$$

Wentworth Hospital's computerised neurosurgical database was used to access the data from the entire catchment area. One hundred per cent of records were retrieved, given that every referral and admission are assigned a code on discharge, and all records are stored in the computerised databank. The study was performed with the assistance of a Medical Research Council post-intern investigator (R P).

The proportion of referrals and admissions from UGH relative to the total number of referrals and admissions in the pre- and post-CT era was assessed. The *P*-values were determined by means of the χ^2 -test. The standard error of

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the difference between the proportions was used to calculate the 95% confidence intervals.

Results

In the 2 years preceding the introduction of a CT scanner at UGH, 536 patients were referred to the neurosurgical unit, whereas in the 2 years following installation of a CT scanner at UGH, 304 patients were referred. This represented a dramatic 43.3% decrease in patient referrals to the central neurosurgical unit in a comparable period (Table I). As a control, patient referrals to the neurosurgical unit from all areas (excluding UGH) over a comparable period were studied. In the latter group patient referrals remained remarkably static, increasing from 8 476 to 8 696 — this represents an increase of only 2.6% (Table I). On statistical analysis, the χ^2 value was 8.6, yielding a *P*-value < 0.005.

Table I. Referrals to the neurosurgical service at Wentworth Hospital in Durban

	From all areas	From Umtata General Hospital
Pre-scanner	8 476	536
Post-scanner	8 694 (+2.6%)	304 (-43.3%)

The admission rate of patients in this study (indicating 'appropriate referrals') sent to the tertiary neurosurgical unit in Durban from UGH increased from 46.3% before peripheral CT facilities to 79.9% after the introduction of this facility (Table II). During the same period, the admission rate of patients referred from all other areas actually decreased, from 50.3% to 46.4% (Table II). On statistical analysis of the number of admissions to Wentworth Hospital, the χ^2 value was 90.5, yielding a *P*-value of < 0.005. The percentage increase in the number of admissions from UGH was 33.6%, with a standard error of 3.15% and a 95% confidence interval between 30.45% and 36.75%, indicating that the increase in the number of admissions from UGH following the installation of a CT scanner was highly significant.

Table II. Admission rates of patients referred to the neurosurgical services at Wentworth Hospital, Durban

	From all areas	From Umtata General Hospital
Pre-scanner	4 265/8 479 (50.3%)	248/536 (46.3%)
Post-scanner	4 036/8 694 (46.4%)	243/304 (79.9%)

Discussion

UGH in the Eastern Cape, situated in the former homeland of Transkei, was chosen as a typical peripheral general regional hospital and it also typifies many of the problems faced by such hospitals in the country. UGH serves a predominantly underdeveloped part of South Africa and is in itself relatively underfunded and understaffed. It is separated from Durban by a notoriously dangerous 400 km stretch of road with only a small section of highway. Typically, critically

ill patients were transported to the neurosurgical unit along this road. The route is unsafe, especially when ambulances are required to travel at high speeds at night on a road that is unlit for most of its length. Added to this is the problem of severe potholes and the ever-present danger of unattended animals crossing the road. Severe accidents have occurred, with loss of life of patients, attendants and drivers. In addition, the ambulance was then unavailable to other deserving patients for nearly a whole day. Furthermore, there have been incidents of ambulances being hijacked en route, compounding the usual near 8-hour delay before the patient reaches Durban. The medical risks to neurosurgical patients being transported in suboptimal conditions are significant.

It was hoped that the introduction of a CT facility at UGH would obviate the need to transport patients not requiring expert or specialist neurosurgical care to the service in Durban, thereby preventing patient and attendants from being exposed to unnecessary risks. However, many medical practitioners, administrators and other staff had severe misgivings about the cost-effectiveness of allocating the large sum of money required to install a CT scanner at a peripheral general hospital serving an underdeveloped population.

Following the installation of the CT scanner at UGH, the number of referrals by road to the neurosurgical unit in Durban was almost halved. This halved the resources needed, and staff and patients were saved the unnecessary risk of being transported to Durban in often dangerous conditions.

Prior to the introduction of CT facilities at UGH and, indeed, in all other areas not possessing CT facilities, 1 in 2 patients could be considered an inappropriate referral (not requiring specialised neurosurgical care), who would subsequently be returned to the base hospital because of the limited facilities at the specialist institution. In the case of UGH, this meant that half of the patients referred and not admitted had to undergo an 8-hour return journey to UGH under suboptimal conditions. Following installation of a CT scanner at UGH, the admission rate (indicating 'appropriate referrals') increased from 46.3% to nearly 80%.

There were, however, a number of confounding factors which could not be assessed and their impact on the study may have been significant. It is possible that the physical condition of the 400 km stretch of road between UGH and Wentworth Hospital deteriorated further during the study period, discouraging patient transfer. Further, the availability of ambulances at UGH and their roadworthiness, and changes, if any, in the transport budget at UGH could not be assessed. There was, to our knowledge, no neurosurgical specialist at UGH during the study period, which could also have affected the patient referral and admission pattern from UGH.

The criteria for admission to the neurosurgical unit at Wentworth Hospital remain uniform and the published protocol (or 'standing orders') for patient management has not changed since 1990. Also, the widely distributed 'indications for neurosurgical consultation' at Wentworth Hospital have remained uniform. The admission criteria of the neurosurgical service at Wentworth Hospital during the study period therefore did not change and could not be considered a confounding factor. However, despite our efforts, an evaluation of patient referral from UGH — i.e. how

many cases ought to have been referred to Wentworth Hospital for neurosurgical care during the study period, but were not — could not be made. This factor may also be considered a confounding factor in our study.

There is admittedly still room for improvement, which can be achieved by CT telefacsimile facilities between UGH and the referral centre in Durban. These facilities are already being utilised by Wentworth Hospital and other metropolitan general hospitals such as King Edward VIII Hospital in Durban. Furthermore, the existence of well-defined criteria for scanning patients and the fostering of increased co-operation and communication between the neurosurgical referral centre and peripheral hospitals are likely to increase the yield of appropriate referrals further.

The comprehensive economics of the impact of a CT facility at UGH on the neurosurgical services of the region has not been evaluated, and further work in this regard is necessary.

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REFERENCE

1. Parboosing R, Nadvi SS, Van Dellen JR. The impact of the introduction of peripheral computerised tomography facilities on a regional neurosurgical unit. 13th Biennial Neurosurgical Congress, Postgraduate Medical Centre, University of Cape Town, South Africa, 8 - 10 September 1994.

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