Multidisciplinary intensive care in Bloemfontein, 1981 - 1984

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Summary
From 1981 to 1984, 1720 patients requiring critical care were admitted to two multidisciplinary intensive care units (MDICUs) run by a department of critical care at the University of the Orange Free State, Bloemfontein. The majority (61%) were referred from outside the metropolitan area. The most important referring specialties were surgery (25%), medicine (19%), orthopaedics (14%), paediatrics (10%) and obstetrics and gynaecology (9%). Almost 50% of patients stayed in the unit for 1 - 4 days while 12% remained for more than 14 days. Average in-unit mortality (IUM) over the 4 years was 27%. The highest annual rate was 38%, but without measurement of severity of illness yearly and unit IUM figures cannot be compared. IUM for patients who remained in the unit for 1 day only (66%) was higher than that for patients remaining for more than 2 weeks (28%).

Consultant and resident cover over the 4-year period was problematic and sometimes inadequate. Care by the referring doctor was impractical and limited numbers of patients in each discipline make independent 'level-1' units (ICU doctor in unit at all times) undesirable.

The cost of care of the 1720 patients over 4 years was approximately R5 700 000. Demand for MDICU care increased by 40% from 1981 to 1984.

Function of the MDICUs
The MDICUs at Pelonomi Hospital (PH) and Universitas Hospital (UH) at present have 6 and 8 beds respectively. While Bloemfontein itself has a population of more than 210,000, these units serve an area of many thousand square kilometres with a population of more than a million. Between 1981 and 1984, 272 494 patients were admitted to Bloemfontein hospitals, 134 144 to PH and 138 350 to UH and the National Hospital combined.

Admission criteria
Criteria for admission to an MDICU are instability of one or more vital organ systems, need for intensive monitoring, and/or need for complicated therapy following trauma, surgery or medical disease. Patients who have had an uncomplicated myocardial infarction or have undergone neurosurgical or thoracic surgical procedures are managed in separate subspecialty intensive care units. Patients are also admitted to surgical ICU's (SICUs) at both PH and UH; these were designed for short-term care only, but because of a shortage of beds and for other reasons some patients who qualify for MDICU admission are cared for in an SICU. Paediatric and neonatal ICUs came into full operation between 1981 and 1984. At present they function independently at both hospitals, but a large number of children has been admitted to the MDICU at UH.

Potential MDICU patients are seen after consultation with the referring doctor and management options are evaluated. Cases are considered with no age restriction if there is a possibility of recovery of acceptable health. Once the patient is admitted, responsibility rests with the full-time critical care personnel.

Equipment and supporting services
Up-to-date equipment, including facilities for thermodilution, estimation of cardiac output and computer-assisted calculation of haemodynamic and respiratory data, is available in both units. Laboratory results can be obtained rapidly, day and night; this is one of the best-developed supportive components of our service.

Medical and nursing staff
Monitoring of all aspects of the patient's condition and provision of supportive measures begins as soon as possible after admission; the necessary biochemical investigations are carried out and appropriate therapy is instituted. The patient's condition is assessed and supportive measures are titrated by the unit resident in close co-operation with the unit consultant and the referring doctor, who is encouraged to see the patient daily and advise on aspects concerning his specialty. Orders for therapy are channelled through the unit doctors, who in turn consult other members of the team when necessary.

A core of nurses trained in intensive care forms the soul of each unit. Although a one-to-one nurse/patient ratio is generally maintained, this ideal is not achieved during all night shifts.

Ways of providing high-quality services to the critically ill and injured need to be considered objectively, bearing in mind the diversity of disciplines involved. Aspects of intensive care unit (ICU) design, patient populations, staffing and organization and education of personnel have been defined and described. During the early 1970s a department of critical care was established at the University of the Orange Free State teaching hospitals and guidelines for multidisciplinary intensive care units (MDICUs) were established in co-operation with other departments. The MDICUs are managed by full-time consultants who take over management of the patient from the referring physician.

Following rapid development in the field of intensive care there has been a plea for documentation of levels of care and analysis of costs and results, but no data on multidisciplinary intensive care in Bloemfontein have been reported. This article supplies some information about our MDICUs and the patients treated there.

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MDICU house staff (clinical assistants) from the departments of surgery, obstetrics and gynaecology, medicine and anaesthetics rotate through the unit for 3 months at a time and are supplemented, on an equal basis, by full-time medical officers, employed by the Province but not registered as postgraduate students. The resident doctors range from those fresh out of internship to others with several years' postgraduate experience.

While 3 resident doctors per unit is regarded as the minimum number for optimal patient care, 24-hour in-unit call-service and research development, these conditions were not met for most of the period under study; at times residents were on 1-in-3 call-service for both units in hospitals 10 km apart. This did not fulfil 'level-1' (ICU doctor in unit available at all times) or 'level-2' (ICU doctor in the hospital at all times) criteria. Consultant availability also varied, with a maximum of 3 full-time consultants, including the head of the department, responsible for patient care, administration, education, research and development.

Discharge criteria
Patients are usually moved to the ward within 48 hours of stabilization of their condition, if ventilation, high-volume intravenous replacement therapy, infusion of potent drugs or specialized cardiovascular monitoring are not required and if underlying disease processes are judged to be under control. Sometimes a patient is transferred to make room for another who is more severely ill. Our usually strict criteria were not enforced rigidly during weekends or if there was little pressure for evacuation of a bed.

Study and methods
The purpose of the study was to determine patient statistics for the preceding 4 years. Numbers of patients, sex, age, place of origin, referring specialty, time in the unit, and survival for the PH and UH MDICUs over the 4-year period 1981 - 1984 were retrospectively determined. Survival was calculated in relation to age groups, length of stay and hospital subgroups, and variations over the 4-year period were assessed. Cost of care was calculated by multiplying the number of days in the unit by a cost-constant.

Results
The total number of patients admitted to Bloemfontein hospitals for 1981 - 1984 was 272 494, of whom 1720 received multidisciplinary critical care (Table I). The male/female ratio was approximately 6:4. Of the patients 58% were aged under 40 years and 17% were aged over 60 years; 511 (51%) of those aged under 40 years were from PH and 490 (49%) from UH, while 47 (6%) of the 291 patients aged over 60 years were from PH and 244 (84%) from UH (Table II) (figures may not be totally accurate, since it is sometimes necessary to estimate ages of black patients).

An average of 17 patients per month were admitted to each unit, while at both hospitals an average of 61% of patients were from outside Bloemfontein (Table I).

Referral pattern. Members of surgical specialties referred 58% of patients, while between 16% and 20% of patients at PH but less than 3% of patients at UH were referred from departments of obstetrics and gynaecology. Although the departments of neurosurgery and thoracic surgery have separate ICUs, averages of 4% and 6% of patients respectively were referred from these two departments after developing respiratory problems, sepsis or multiple organ failure necessitating help with care. Referral patterns were consistent over the 4 years (Table III) with the exception of paediatric patients at PH since 1983, after the opening of paediatric and neonatal ICUs, and some increase in patients referred by private doctors at UH.

Time in MDICU. Forty-nine per cent of patients remained in the unit for less than 5 days and 75% for less than 10 days. Only 12% stayed for more than 14 days (Table IV).

Growth. Numbers of patients admitted increased between 7% and 9% per unit per year and between 41% and 46% per unit over the 4-year period (figures represent the minimum and maximum
Table III. Referring Departments

<table>
<thead>
<tr>
<th>Year</th>
<th>PH</th>
<th>UH</th>
<th>PH</th>
<th>UH</th>
<th>PH</th>
<th>UH</th>
<th>PH</th>
<th>UH</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>20</td>
<td>28</td>
<td>7</td>
<td>36</td>
<td>47</td>
<td>3</td>
<td>30</td>
<td>171</td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>41</td>
<td>70</td>
<td>31</td>
<td>72</td>
<td>31</td>
<td>52</td>
<td>38</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>32</td>
<td>39</td>
<td>33</td>
<td>43</td>
<td>33</td>
<td>48</td>
<td>53</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td>31</td>
<td>26</td>
<td>29</td>
<td>23</td>
<td>38</td>
<td>25</td>
<td>37</td>
<td>247</td>
<td></td>
</tr>
</tbody>
</table>

*Referred by non-academic physicians.

Table IV. Time in MICUs (% of Patients)

<table>
<thead>
<tr>
<th>Days</th>
<th>1 - 4</th>
<th>5 - 9</th>
<th>10 - 14</th>
<th>&gt; 14</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>41</td>
<td>26</td>
<td>9</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>1982</td>
<td>57</td>
<td>24</td>
<td>8</td>
<td>11</td>
<td>—</td>
</tr>
<tr>
<td>1983</td>
<td>43</td>
<td>31</td>
<td>13</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>1984</td>
<td>49</td>
<td>22</td>
<td>14</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Average</td>
<td>49</td>
<td>26</td>
<td>12</td>
<td>12</td>
<td>2</td>
</tr>
</tbody>
</table>

* < 1% indicated as —.

Discussion

The percentage of patients who came from outside Bloemfontein, the male/female ratio, the age distribution, time in the unit and referral patterns remained similar from 1981 to 1984.

Mortality. In-unit mortality (IUM) varied from 21% (UH, 1981) to 38% (PH, 1983) per year with an average of 27% over the 4-year period. IUM for the over-60-year age group was 33%, compared with 25% for patients aged under 40 years. Fourteen (30%) of the 47 patients aged over 60 at PH died, compared with 82 (34%) of the 244 patients aged over 60 at UH. Mortality in patients aged under 40 years was 30% (151 of 511) at PH and 20% (98 of 486) at UH (Table V). Of the approximately 200 patients who remained in the MICU for longer than 14 days the majority (72%) survived, while death was the most important cause of a short stay in the unit; of the 95 patients who were there for only 1 day 66% died.

Costs. Total costs, calculated at R500 per day per patient (J. B. de Vaal — personal communication), amounted to R5 692 000 (1 720 patients treated for a grand total of 11 384 days). The average cost per survivor works out at R4 513. Costs for patients remaining in the unit for longer than 14 days amounted to R2 202 000, and the cost per survivor then was R19 660.

Table V. Survival in Relation to Age

<table>
<thead>
<tr>
<th>Year</th>
<th>Over 60 yrs</th>
<th>Under 40 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of patients</td>
<td>Mean age</td>
</tr>
<tr>
<td>1981</td>
<td>8</td>
<td>64</td>
</tr>
<tr>
<td>1982</td>
<td>54</td>
<td>71</td>
</tr>
<tr>
<td>1983</td>
<td>13</td>
<td>66</td>
</tr>
<tr>
<td>1984</td>
<td>8</td>
<td>64</td>
</tr>
<tr>
<td>Total</td>
<td>291</td>
<td>67</td>
</tr>
</tbody>
</table>

82 (34%) of the 244 patients aged over 60 at UH. Mortality in patients aged under 40 years was 30% (151 of 511) at PH and 20% (98 of 486) at UH (Table V). Of the approximately 200 patients who remained in the MICU for longer than 14 days the majority (72%) survived, while death was the most important cause of a short stay in the unit; of the 95 patients who were there for only 1 day 66% died.

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Discussion

The percentage of patients who came from outside Bloemfontein, the male/female ratio, the age distribution, time in the unit and referral patterns remained similar from 1981 to 1984.

Mortality. In our MICUs (27%) is relatively high, reflecting the fact that the patients admitted are severely ill. Some units with a different population publish much lower mortality rates — Tomlin16 reports an IUM of only 13.5% in a unit in the UK over a 4-year period; 40% of patients stayed for 1 day only. Nunan17 reports 12.5 - 33% mortality rates for patients ventilated in ICUs in the UK.

It is difficult to relate the patient profile to the time patients spend in an ICU. In a study in the UK12 70% of 'multi-
Advantages and disadvantages of an MDICU

On reviewing our statistics it is appropriate to consider how critical care may best be delivered and to mention advantages and disadvantages of centralized critical care in the form of a department run by full-time critical care personnel. Management of the critically ill patient by a special team as opposed to management by the referring doctor may be beneficial as regards training, education and continuity of care, and costs are likely to be lower and care better when very ill patients are grouped together.

When numbers of very ill patients requiring critical care by single specialties are small, separate level-I units for each discipline are not justified (Table III), since level-I care demands 24-in-unit call and appropriate consultant cover. Inadequate cover leads to 'rounding' and prescribing by doctors instead of the 'titrated management' needed by critically ill patients. An integrated approach whereby each case is reviewed systematically more than once a day leads to better care. In our situation the number of patients from outside Bloemfontein makes care by the referring physician even more unsuitable.

Proper after-hours cover in our units was problematic and a source of frustration to doctors and their families. More full-time MDICU staff rather than temporary after-hours cover by members of other departments would provide continuity of care, lack of which generates low morale, while assignment of residents to a unit for a short period discourages active involvement in patient management.

Disadvantages of an MDICU include 'dumping' and transfer of patients during weekends and holiday periods with insufficient work-up by a referring doctor. The MDICU should be used when admission is indicated and not only when convenient for the referring doctor. 'Consumer disciplines' should accept the idea of care by a team, and referring doctors should list all problems discovered or feared, work done so far and therapeutic options considered before the patient is transferred. Experienced residents sometimes work alone until problems get totally out of hand before MDICU consultation; on the other hand, doctors with insufficient senior cover request help from MDICU residents when help from within their departments might be more appropriate.

Good MDICU care seems to cause a drop in the standard of nursing of seriously ill patients in the wards, and proper screening of patients for admission is essential. This should ideally be done at the bedside with the referring doctor present.

The rapid development of critical care and the great demands made by it mean that our greatest challenge is to produce physicians capable of co-ordinating MDICU care. Because of lack of promotion possibilities, no availability of extra qualifications and stressful work conditions, medical officer posts (generally not recognized by the South African Medical and Dental Council for specialist training) have a high turnover rate. Doctors tend to use these posts to fill in time or to gain experience before specialization or entry to private practice.

In the UK the Intensive Care Society recommends that ICU training should produce clinicians fully competent in all aspects of management of the critically ill patient. Consultants should be specialists in all aspects of acute medicine, including administration, planning and organization of a unit; this takes much longer than the 3 months our residents spend in critical care.

Lack of full-time ICU consultants seems to be universal. Our problems in providing high-level cover 24 hours a day at two hospitals with 3 full-time consultants periods of rapid changeover in resident staff are obvious. At present the stress on individual consultants is a problem; demands made by patient care and education of medical and nursing staff leave inadequate

disciplinary' patients remained in the unit for less than 5 days, in contrast to 49% of our MDICU patients. In this study the major referring specialties were cardiothoracic surgery (27% of patients), general surgery (17%) and general medicine (33%); our figures for these were 6%, 25% and 19% respectively.

Differences in IUM between years and hospitals were significant, but without a measure of severity of illness differences in units and years cannot be compared and do not reflect variation in the effectiveness of therapy. Use of a daily therapeutic intervention scoring system (the TISS count) as an indication of the level of support given to patients, may make better comparisons possible. A prospective sample of 61 MDICU patients showed no difference between UH and PH (unpublished data). The mean maximum TISS was 35 points during support. On discharge patients at PH had an average of 19 points, compared with 26 points at UH. It may be significant that during 1982 the unit with the highest mortality (PH) did not have a full-time consultant. Academic support on consultant level does influence mortality.

The low survival rate (34%) for patients who remained in the units for 1 day only is an indication that a number of severely ill patients are admitted as a last resort. The majority (72%) of long-stay patients (14 days) survived, in contrast with the commonly held belief that most of these patients die. The time and money spent on patients who do not get better within the first few days may well be worth the effort, although we must keep in mind that high-technology medicine may also contribute to the death of some who become victims of the critical care process.

We do not know the long-term survival rate of our patients, but studies by Cullen of class IV patients (TISS > 40 points) demonstrated an in-hospital mortality rate of 69 - 73%.

Increases in the number of patients from 1981 to 1984 amounted to as much as 40%. As unit staffing remained virtually constant, productivity of personnel must have increased.

Only 0,63% of patients admitted to non-psychiatric departments at Bloemfontein hospitals received treatment in an MDICU, but the cost of treatment of this fraction amounted to more than R1,4 million per year. Compared with other centres the MDICUs may be relatively inexpensive. Cost of intensive care increasingly comes under scrutiny, and the question who should receive it needs to be examined. Age should not determine whether or not a patient receives aggressive care in the ICU. In a study by Fedullo and Swinburne costs and duration of care did not vary with age. In our MDICUs, IUM for patients aged over 60 years (33%) compared favourably with the IUM for all patients (27%) and that for patients aged under 40 (25%).

Most critically ill patients should receive aggressive support for at least 24 hours before reassessment of the prognosis, but reluctance to withdraw it later, even when it becomes futile, may be a problem. In this situation we did not institute new therapy on condition the family accepted our decision.

Trained individuals may be of value in determining need for MDICU care. Risk estimation may be a safe approach to early discharge. According to Downs this role could justify the existence of the critical care specialist from a purely economic standpoint.

Our costs are not passed on to the consumer or to medical aid societies. At the moment private MDICU patients (those who in general can afford to pay through insurance or other means) are billed only for radiological investigations and fresh blood products and according to a sliding scale for the bed. Hospital patients (paid for by the State) only pay a sliding-scale bed rate.
time for research and may be more stressful in full-time critical care than elsewhere. Since 1980 no individual who has qualified as a specialist has seriously considered full-time critical care as a career.

Services outside an academic faculty are less expensive than those inside, but in-hospital mortality rates may be up to one-third higher. It seems that at present management of ICUs is haphazard and standards are variable, with few trained consultants committed to co-ordination and training, and that there are diverse views on how ICUs should be run. Some surgeons consider that the patient is best cared for by the surgeon, for 'only he knows the full significance of details of the operation'. In my opinion this does not necessarily imply that aftercare by the surgeon will be good. While there is no doubt that some surgeons have the ability to manage very ill patients, like management of the patient under anaesthesia this is best delegated. Doctors cannot operate, run busy practices or clinics and care for critically ill patients, all at the same time, without compromising the standard of care.

Conclusion

The demand for critical care is growing. The number of patients admitted, therapeutic interventions required, mortality rates and the cost of critical care indicate that optimal care demands continuous intensive attention, best provided in a well-organized unit by full-time personnel. Without statistics for a control group of patients, it is difficult to evaluate MDICU function objectively, but these units set standards of critical care against which further studies of results as well as monetary and human costs may be compared.

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REFERENCES