Introduction
A growing awareness of the differences that existed within South Africa in terms of the management of Neurosurgical patients prompted the academic Neurosurgical unit at Wentworth hospital to embark on a nationwide survey to determine a national management standard for Neurosurgical patients.

The objectives of the study
Primary objective: to determine present South African practice standards in key areas of Neurosurgery.
Secondary objective: to determine whether specific factors, including the postgraduate training centre, the region of practice, public and/or private sector practice, influenced patient management strategies.

Method
Questionnaires were circulated to the 84 members of the Society of Neurosurgeons of South Africa, a group encompassing the majority of neurosurgeons practicing within the borders of South Africa. Additional questionnaires were distributed at related anaesthetic and neurosurgical scientific meetings.

The survey identified key areas of patient management including subarachnoid haemorrhage (SAH), traumatic brain injuries (TBI), posterior fossa and spinal surgery.

Statistical analysis of the data received was performed to determine correlations between demographic factors and management protocols. Statistical methods included Chi-square, Likelihood ratio Chi-square, Mantel-Haenszel Chi-square and Fisher’s exact test

Results
In the survey a thirty-eight percent response was achieved to the initial circulation of questionnaires. Subsequently an additional six returns were received at related scientific meetings.

Table 1: Graduation Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1960</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>1960-69</td>
<td>3</td>
<td>7.9%</td>
</tr>
<tr>
<td>1970-79</td>
<td>10</td>
<td>26.3%</td>
</tr>
<tr>
<td>1980-89</td>
<td>7</td>
<td>18.4%</td>
</tr>
<tr>
<td>1990-99</td>
<td>13</td>
<td>34.2%</td>
</tr>
<tr>
<td>2000-01</td>
<td>4</td>
<td>10.5%</td>
</tr>
</tbody>
</table>

Table 2: Postgraduate Training Centre

<table>
<thead>
<tr>
<th>Centre</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Town *</td>
<td>7</td>
<td>17%</td>
</tr>
<tr>
<td>Stellenbosch*</td>
<td>6</td>
<td>16%</td>
</tr>
<tr>
<td>Natal *</td>
<td>5</td>
<td>13%</td>
</tr>
<tr>
<td>Pretoria*</td>
<td>5</td>
<td>13%</td>
</tr>
<tr>
<td>MEDUNSA*</td>
<td>3</td>
<td>8%</td>
</tr>
<tr>
<td>Orange Free State*</td>
<td>3</td>
<td>8%</td>
</tr>
<tr>
<td>Nigeria**</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>New Zealand**</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>United Kingdom**</td>
<td>1</td>
<td>3%</td>
</tr>
</tbody>
</table>

Of interest in terms of the current debate concerning the need for a national unitary exit exam was the distribution between Masters and Fellowship qualifications as the route to special-

Respondent Data and Demographics
By far the greater majority of the respondents, 94.7%, were male. This closely reflects the present demographics of South African neurosurgeons where female surgeons have made little inroads into the male dominated field of Neurosurgery.

The large majority of respondents 89.5% graduated after 1970, with 50% graduating after 1989. A more detailed breakdown of the results is shown in Table 1.

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Dr Clive Daniel
email: daniel@ukzn.ac.za

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Respondents active in the private sector accounted for two thirds (68.4%) of the replies with respondents confined to public sector activity accounting for the remaining third. There was some degree of overlap between the two sectors, outlined in Table 4, with a number of individual respondents being active in both segments.

The region in which the respondent practised was also of particular interest to us (Table 5). It was felt important to differentiate between the regions in which the respondents practised as opposed to the postgraduate training centres attended, in order to determine what factor had the greatest influence on patient management strategies.

### Patient Management Strategies

The survey in turn focussed on the management of subarachnoid haemorrhage, intracranial aneurysm surgery, traumatic brain injury and monitoring and positioning aspects of posterior fossa and spinal surgery.

### Medical Management of Sub-Arachnoid Haemorrhage (SAH)

The survey looked at medical management of SAH and surgical management of intracranial aneurysms separately. The result of the survey of medical management of SAH is tabulated in Table 6.

### Detection of Vasospasm in SAH Disease

In terms of the method of detection employed, it was noted that although the majority of respondents, 94.7%, utilised clinical methods for the detection of vasospasm, most of these, 71.1%, supplemented clinical methods with angiography. Transcranial doppler detection was used by a minority, 21.1%, while only one respondent employed a cerebral flow study detection method.

### Perioperative Management of Intracranial Aneurysm Surgery Patients

Distinct differences were noted in the perioperative approach to Aneurysm surgery with particular reference to the use of early and late clipping of aneurysms’ and temporary clipping during surgery. There were also notable differences in terms

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### Table 3: Postgraduate Masters Degree

<table>
<thead>
<tr>
<th>University</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stellenbosch</td>
<td>6</td>
<td>15.8%</td>
</tr>
<tr>
<td>Orange Free State</td>
<td>4</td>
<td>10.5%</td>
</tr>
<tr>
<td>MEDUNSA</td>
<td>3</td>
<td>7.9%</td>
</tr>
<tr>
<td>Pretoria</td>
<td>3</td>
<td>7.9%</td>
</tr>
<tr>
<td>Natal</td>
<td>2</td>
<td>5.3%</td>
</tr>
<tr>
<td>Cape Town</td>
<td>2</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

### Table 4: Practice Sector*

<table>
<thead>
<tr>
<th>Practice Sector</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Practice (PP) only</td>
<td>23</td>
<td>60.5%</td>
</tr>
<tr>
<td>PP + Service Hospital</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>PP + Academic Hospital</td>
<td>2</td>
<td>5.3%</td>
</tr>
<tr>
<td>Academic Hospital only</td>
<td>8</td>
<td>21.0%</td>
</tr>
<tr>
<td>Academic Hospital +PP</td>
<td>2</td>
<td>5.3%</td>
</tr>
<tr>
<td>Service Hospital only</td>
<td>2</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

* Predominant Area of Practice listed first

### Table 5: Practice Region

<table>
<thead>
<tr>
<th>Province*/Country**</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Cape *</td>
<td>12</td>
<td>31.6%</td>
</tr>
<tr>
<td>Gauteng *</td>
<td>10</td>
<td>26.3%</td>
</tr>
<tr>
<td>KwaZulu-Natal *</td>
<td>8</td>
<td>21.1%</td>
</tr>
<tr>
<td>Eastern Cape *</td>
<td>4</td>
<td>10.5%</td>
</tr>
<tr>
<td>Northern *</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>Orange Free State *</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>Namibia **</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>Nigeria **</td>
<td>1</td>
<td>2.6%</td>
</tr>
</tbody>
</table>

* Province is Indonesia, Country is China

### Table 6: Medical Management of Sub-Arachnoid Haemorrhage

<table>
<thead>
<tr>
<th>Triple Therapy</th>
<th>Routinely</th>
<th>Occasionally</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypervolemia only</td>
<td>6</td>
<td>15.8%</td>
<td>18</td>
</tr>
<tr>
<td>Hypervolemia &amp; Haemodilution (HH)</td>
<td>8</td>
<td>21.1%</td>
<td>16</td>
</tr>
<tr>
<td>Hypertension and HH</td>
<td>6</td>
<td>15.8%</td>
<td>17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nimodipine Therapy</th>
<th>Intravenously</th>
<th>Orally</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12</td>
<td>31.5%</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anti-fibrinolytic Therapy</th>
<th>Not Used</th>
<th>Routinely</th>
<th>As Indicated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>26</td>
<td>68.4%</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>__ – Blockade Therapy</th>
<th>Not Used</th>
<th>Routinely</th>
<th>As Indicated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>26.3%</td>
<td>3</td>
</tr>
</tbody>
</table>
of the utilization of hypotension, hypothermia and brain protection strategies. The results of the survey of intraoperative management strategies are summarised in tables 7 to 11.

Table 7: Early and Late Clipping of Aneurysms

<table>
<thead>
<tr>
<th></th>
<th>Early &lt; 7 days</th>
<th>Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>%</td>
<td>Number</td>
</tr>
<tr>
<td>Anterior Circulation</td>
<td>27</td>
<td>71.1%</td>
</tr>
<tr>
<td>Posterior Circulation</td>
<td>14</td>
<td>36.9%</td>
</tr>
</tbody>
</table>

Table 8: Temporary Clipping of Aneurysms

<table>
<thead>
<tr>
<th>Clipping duration (minutes)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior Circulation</td>
<td>3</td>
<td>20</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Posterior Circulation</td>
<td>3</td>
<td>20</td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 9: Blood Pressure Control during Aneurysm Surgery

<table>
<thead>
<tr>
<th>Method</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normotension throughout</td>
<td>18</td>
<td>47.4%</td>
</tr>
<tr>
<td>Deliberate Hypotension below 100mmHg</td>
<td>2</td>
<td>5.3%</td>
</tr>
<tr>
<td>Hypotension on Aneurysm Rupture only</td>
<td>16</td>
<td>42.1%</td>
</tr>
</tbody>
</table>

63.1% still saw a role for Barbiturate coma in the management of refractory ICP elevations. Jugular bulb saturation monitoring (JBSM), that enjoys growing popularity internationally, has not made significant inroads into South African practice with only 5.6% of respondents indicating use of this valuable method of monitoring in TBI.

Table 12: Extubation following Aneurysm Surgery

<table>
<thead>
<tr>
<th>Extubation</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Deep&quot; extubation</td>
<td>7</td>
<td>18.4%</td>
</tr>
<tr>
<td>Delayed “Awake” extubation</td>
<td>15</td>
<td>39.5%</td>
</tr>
</tbody>
</table>

Table 13: Postoperative ICU Management

<table>
<thead>
<tr>
<th>Director of management</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurosurgeon</td>
<td>18</td>
<td>47.4%</td>
</tr>
<tr>
<td>Anaesthesiologist</td>
<td>4</td>
<td>10.5%</td>
</tr>
<tr>
<td>Intensivist</td>
<td>3</td>
<td>7.9%</td>
</tr>
<tr>
<td>Team approach</td>
<td>16</td>
<td>42.1%</td>
</tr>
</tbody>
</table>

Table 14: Intracranial pressure monitoring in TBI

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ICP monitoring utilised</td>
<td>8</td>
<td>21.1%</td>
</tr>
<tr>
<td>Intraventricular</td>
<td>12</td>
<td>31.6%</td>
</tr>
<tr>
<td>Parenchymal</td>
<td>11</td>
<td>28.9%</td>
</tr>
<tr>
<td>Subdural</td>
<td>15</td>
<td>39.6%</td>
</tr>
<tr>
<td>Extradural</td>
<td>2</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

Table 15: Oral versus Nasal intubation for Airway Control in TBI

<table>
<thead>
<tr>
<th>Intubation</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral intubation</td>
<td>15</td>
<td>39.5%</td>
</tr>
<tr>
<td>Nasal intubation</td>
<td>23</td>
<td>60.5%</td>
</tr>
</tbody>
</table>

Postoperative Management of Intracranial Aneurysm Surgery Patients

Tables 12 and 13 looked at postoperative management issues with the majority of respondents favouring a delayed approach to extubation.

The Management of Traumatic Brain Injury (TBI)

The survey on the management of TBI in particular studied the use of intracranial pressure (ICP) monitoring (Table 14), intubation strategies (Tables 15 and 16), and interventions aimed at the reduction of secondary brain injury. These included targeted hyperventilation that had become unpopular (Tables 17 and 18), and hypothermia (Table 19), that was very much in vogue internationally at the time of the survey.

Table 10: Brain Protective measures during Aneurysm Surgery

<table>
<thead>
<tr>
<th>Method</th>
<th>Routinely</th>
<th>Infrequently</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>Mannitol</td>
<td>28</td>
<td>73.7%</td>
<td>10</td>
</tr>
<tr>
<td>Barbiturates</td>
<td>8</td>
<td>21.1%</td>
<td>22</td>
</tr>
<tr>
<td>Propofol</td>
<td>4</td>
<td>10.5%</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>36-37°C</td>
<td>34-35°C</td>
<td>&lt;34°C</td>
</tr>
<tr>
<td>Hypothermia</td>
<td>13</td>
<td>34.2%</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 11: PaCO$_2$ control during Aneurysm Surgery

<table>
<thead>
<tr>
<th>Targeted Levels</th>
<th>3.8 kPa</th>
<th>3.3-6.6 kPa</th>
<th>&gt;6.6 kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8</td>
<td>21.1%</td>
<td>21</td>
</tr>
</tbody>
</table>
Neurosurgical Patient Positioning

The final section of the survey focussed on monitoring and positioning of patients for posterior fossa and spinal surgery. Of interest was the fact that in keeping with international trends, the majority of respondents, 63.2%, did not use the sitting position. The breakdown of the usage of the sitting position and related monitoring employed by respondents is depicted in Tables 20 and 21.

The final section of this survey looked at the use of the prone position. Table 22 depicts the use of precautionary measures and monitoring for posterior fossa surgery in the prone position while Table 23 summarises the usage of various devices during prone spinal surgery.

Results of Statistical Analysis of Respondent Data

The secondary objective of the survey had been to determine whether specific factors, including centres for postgraduate train-

<table>
<thead>
<tr>
<th>GCS level as determined post-surgically:</th>
</tr>
</thead>
</table>

### Table 16: Glasgow Coma Score (GCS) as indication for intubation - TBI

<table>
<thead>
<tr>
<th>GCS less than 12**</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCS less than 11</td>
<td>2</td>
<td>5.3%</td>
</tr>
<tr>
<td>GCS less than 10</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>GCS less than 9</td>
<td>3</td>
<td>7.9%</td>
</tr>
<tr>
<td>GCS less than 8</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>GCS less than 7</td>
<td>12</td>
<td>31.6%</td>
</tr>
<tr>
<td>GCS less than 7</td>
<td>1</td>
<td>2.6%</td>
</tr>
</tbody>
</table>

**GCS level as determined post-surgically.

### Table 17: Hyperventilation in TBI

<table>
<thead>
<tr>
<th>Hyperventilation</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not utilized</td>
<td>4</td>
<td>10.5%</td>
</tr>
<tr>
<td>Routine</td>
<td>8</td>
<td>21.1%</td>
</tr>
<tr>
<td>Targeted cases</td>
<td>25</td>
<td>67.8%</td>
</tr>
</tbody>
</table>

### Table 18: Pa CO2 targets during Hyperventilation in TBI

<table>
<thead>
<tr>
<th>Pa CO2 targets</th>
<th>3.8 kPa</th>
<th>3.9-4.6 kPa</th>
<th>&gt;4.6 kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine</td>
<td>6</td>
<td>15.8%</td>
<td>0</td>
</tr>
<tr>
<td>Targeted</td>
<td>7</td>
<td>18.4%</td>
<td>18</td>
</tr>
</tbody>
</table>

### Table 19: Hypothermia in TBI

<table>
<thead>
<tr>
<th>Hypothermia</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not utilized</td>
<td>27</td>
<td>71.0%</td>
</tr>
<tr>
<td>Routine</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Infrrequently</td>
<td>11</td>
<td>28.9%</td>
</tr>
</tbody>
</table>

### Table 20: Sitting position utilization in Neurosurgery

<table>
<thead>
<tr>
<th>Procedures performed in sitting position</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical foraminotomy / laminectomy</td>
<td>7</td>
<td>18.4%</td>
</tr>
<tr>
<td>Pineal region tumour</td>
<td>5</td>
<td>13.2%</td>
</tr>
<tr>
<td>Posterior fossa surgery</td>
<td>8</td>
<td>21.1%</td>
</tr>
<tr>
<td>Acoustic neuroma</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>10.6%</td>
</tr>
</tbody>
</table>

### Table 21: Monitoring utilization in the Sitting position in Neurosurgery

<table>
<thead>
<tr>
<th>Monitoring device</th>
<th>Number</th>
<th>Percentage**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial line</td>
<td>15</td>
<td>93.8%</td>
</tr>
<tr>
<td>Multi-orifice central venous line</td>
<td>16</td>
<td>100.0%</td>
</tr>
<tr>
<td>Præcordial doppler</td>
<td>9</td>
<td>56.3%</td>
</tr>
<tr>
<td>Transoesophageal echocardiography</td>
<td>5</td>
<td>31.3%</td>
</tr>
</tbody>
</table>

** Expressed as a percentage of the respondents who completed this section only

### Table 22: Precautionary measures utilized in the prone position**

<table>
<thead>
<tr>
<th>Device</th>
<th>Number</th>
<th>Percentage**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayfield pins</td>
<td>23</td>
<td>60.5%</td>
</tr>
<tr>
<td>Horse shoe</td>
<td>12</td>
<td>31.6%</td>
</tr>
<tr>
<td>Gel pads</td>
<td>3</td>
<td>7.9%</td>
</tr>
<tr>
<td>Eye lubricants</td>
<td>8</td>
<td>21.1%</td>
</tr>
</tbody>
</table>

** Respondents were free to list, devices not predetermined

### Table 23: Monitoring utilized in prone position Posterior Fossa surgery

<table>
<thead>
<tr>
<th>Monitoring device</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial line</td>
<td>36</td>
<td>94.7%</td>
</tr>
<tr>
<td>Central venous line</td>
<td>34</td>
<td>89.5%</td>
</tr>
</tbody>
</table>

*21.1% out of total 38 respondents or 72% out of 11 respondents utilizing hypothermia
Discussion

Although the relatively low 38% return of completed questionnaires was of concern in terms of the interpretation of statistical data, the sample did contain representation from all the postgraduate Neurosurgical training centres and all the major practice regions in South Africa. Overall practice standards followed international trends with the exception of use of routine hyperventilation in TBI by a significant proportion of the respondents and the fact that Jugular Bulb Saturation monitoring has not made major inroads into South African practice.

The route for placement of CVP’s is contrary to British trends3. In South Africa the ante-cubital route was shown to be unpopular whilst the subclavian route is commonly used. Use of CVP’s in aneurysm surgery is also higher in South Africa; 97% versus 76% in the UK. The Region in which the respondents practised did not appear to influence management practice to any significant extent although statistical significant correlations were found in relation to ICP and CVP monitoring techniques. Age and the Postgraduate Training centre had a far greater effect on patient management strategies.

Conclusion

Generally management practice standards were found to be in keeping with international trends. The use of routine hyperventilation in TBI (PaCO₂ of less than 3.9 kpa without JBSM) by 15.8% is noted with some concern. Regional factors did not appear to influence management practices to any great extent. The analysis of the data supported the view that it was what you were taught at the time of your postgraduate training that was most likely to influence your management strategies. The down side of this finding is that was the older practitioners tend to continue with older and in some cases obsolete techniques practised at the time of their training. They appeared to avoid newer developments in patient management strategy, in some instances to the possible detriment of their patients. This makes a strong case for the need for continuing professional development (CPD) but does not necessarily support the view that CPD in its present form is functioning in South Africa.

References
3. Milis SJ; Anesthesia 2001 56;465-469.