Foreword

This report is of the activity and outcomes in Scottish Intensive Care Units (ICU) and High Dependency Units (HDU) for 2010. It is the culmination of work which has produced a continuous database since 1995. Scottish Intensive Care Society Audit Group (SICSAG) is a National audit funded through Information Services Division (ISD), NHS National Services Scotland. We exist to improve the quality of care delivered to Critical Care patients by monitoring and comparing activities and outcomes across Scottish Critical Care. We intend to drive standards and quality of care upward by engagement with clinical staff, and to provide them with information that can be used in quality improvement programmes.

This report is the fourth year where we publish case mix and illness severity adjusted outcomes from general ICU admission at unit level for a nation’s entire adult population. This remains the only ICU audit in the world, to our knowledge, which does so to this level of public scrutiny.

We are also conscious that other data on unit activities, capacity issues, interventions and staffing is important for comparison and benchmarking. Each year we try to improve the presentation of this information for clinicians and managers to help them plan services.

In collaboration with Health Protection Scotland (HPS) we have now established Healthcare Associated Infection (HAI) surveillance across all 23 Scottish ICU’s in 2010. The first annual national report from HPS and SICSAG will be published in tandem with this one.

We have developed a wide range of measurements which can be used for quality improvement which are evident in the tables and graphs in this report.

In 2011, SICSAG has also worked with multidisciplinary representatives from the Scottish Intensive Care Society to develop a formal suite of Quality Indicators for all Scottish Critical Care units. At time of writing this is out for wide consultation to clinicians, patient representatives and Health Improvement Scotland.

Further discussion and debate on the content of these documents will take place at the SICSAG Annual Conference with the Scottish Critical Care Trials Group and SICS Evidence Based Medicine Group in Stirling on September 29th and 30th. Details of this and further information are available at www.sicsag.scot.nhs.uk.

Thanks for the continued success of this audit once more go to: Scottish Critical Care clinical staff, the SICSAG Steering Group, Moranne MacGillivray (Quality Assurance Manager and Acting National Clinical Co-ordinator), Hazel Mackay (Senior Information Analyst) and the network of local and regional National Audit Team coordinators.

Dr Brian Cook

Chairman
Introduction

It is the aim of the Scottish Intensive Care Society Audit Group (SICSAG) to improve the quality of care of all Critical Care patients by systematic, comprehensive audit of their management and outcomes and supporting the effective use of these data. In 2010, Critical Care units in Scotland admitted more than 35,000 of the most severely ill or injured patients, requiring specialist care and treatment.

This year, we are reporting on the management of 9,802 patients admitted to ICU and Combined Units (units with a combination of ICU and HDU beds) and 25,305 patients admitted to HDU during 2010. This report summarises data that have been collected via a bespoke electronic database (WardWatcher), within Critical Care units in Scotland. The format continues to follow the patient’s journey through three sections: activity, interventions and outcomes with data presented in tables, charts and accompanying text to alert the reader to points of interest.

SICSAG PROGRAMME OF WORK 2010/2011

- Monthly reporting for all units
- Nurse User Group
- The distribution and ongoing development of resource packs
- Ongoing collaboration with other national projects
- Annual Combined Critical Care Conference.
- Development of Quality Indicators in Critical Care
- Optimising the database
- Improve/assure data quality (See Appendix 1)

Monthly reporting

All units are now receiving monthly reports. The turnaround of these reports is approximately 4-6 weeks after the end of the reporting period.

Included in the ICU monthly report is the Cumulative Sum chart (CuSum). The CuSum track chart is an early warning system for changing mortality rates. These charts are process charts and have been introduced to enable early notification of unexpected deaths.

Nurse User Group

Nurse User Group meetings are now being held every 4-6 months with attendance from nursing staff across Scotland. A representative (Staff Nurse Marie Clarence) has been selected from this group to represent HDU nurses on the SICSAG Steering Group.

Resource packs

Resource packs have been distributed to ensure members of staff have all the information necessary to enable individual units to access and utilise the data they have collected. These packs currently contain the first four sections: Getting Started; HELP pages (definitions to all mandatory data); Searching and Reporting; and Administrator Tasks. Sections to follow will include information on Healthcare Associated Infection data collection and Data Management.
Collaboration with other national projects

Health Protection Scotland (HPS)
The first combined SICSAG and HPS pilot report on the national incidence of ICU associated infections was published in March 2011. These data will now be reported annually.

Scottish Patient Safety Programme (SPSP)
SICSAG continue to support the work of the SPSP, and will feature some presentations on quality improvements at this year’s annual Conference.

Combined Critical Care Conference
The annual Combined Critical Care Conference (combined with the Scottish Critical Care Trials Group and Scottish Evidence Based Medicine Group) allows presentation of data and discussion around quality improvement between multi-disciplinary staff from all over Scotland. This year’s conference is at the Stirling Management Centre, on Thursday 29th and Friday 30th September. See website for details: www.sicsag.scot.nhs.uk

Quality Indicators
NHS quality indicators are defined as being person-centred, safe, effective, efficient, equitable and timely. In January 2011, the Scottish Intensive Care Society (SICS) Quality Improvement Group (members from SICS and SICSAG) met to discuss and develop Quality Indicators (QIs) for Critical Care in Scotland. The nature of the Scottish Critical Care community has always been unified in how we measure quality, and for this reason we have recommended a common set of QIs for all Scottish Critical Care patients, collected by all units. The proposed indicators and standards are the beginning. As the process evolves, we envisage it will help to improve the wellbeing of Critical Care patients in Scotland. A discussion document has been circulated to all Critical Care units in Scotland which requires comment and debate among Critical Care clinicians, nurses and patient group representatives in Scotland before implementation.

Optimising the database
In 2010/2011 an extensive review of the historical database has been undertaken, building on previous work done in 2009/2010. Further work has been carried out to input missing information. There has been emphasis on creating a database which can be used to carry out trend analysis which is consistent and comparable taking into account the WardWatcher upgrade in 2008/2009. This work will be carried forward into 2011/2012, with the aim of creating a rationalised set of databases which can be used for efficient analysis. The SICSAG database should be regarded as dynamic and ongoing validation of data may mean that the data is subject to change.

Closed Units
In March 2011, the ICU and HDU at Stobhill hospital closed, and their beds merged with the ICU in Glasgow Royal Infirmary. In July 2011 the ICU and HDU in Stirling Royal Infirmary merged and moved to the new Forth Valley Royal Hospital in Larbert.
Units joining audit in:

2010:  
  Medical HDU Queen Margaret Hospital, Dunfermline
  Medical HDU Victoria Hospital, Kirkcaldy
  HDU Western Infirmary, Glasgow
  Neurological (Level 1) Western General Hospital, Edinburgh

2011:  
  Renal HDU Queen Margaret Hospital, Dunfermline
  Medical HDU Hairmyres Hospital, East Kilbride
  HDU Belford Hospital, Fort William
  HDU Balfour Hospital, Orkney

2011/2012:  
  HDU Lorn & Islands Hospital, Oban
  HDU Caithness Hospital, Wick
  Cardiothoracic ICU & HDU Edinburgh Royal Infirmary
  Cardiothoracic ICU & HDU Golden Jubilee National Hospital, Clydebank

Moranne MacGillivray
Acting National Clinical Coordinator
Summary and Key Findings

This report is the latest in a series from SICSAG which started in 1995. It contains information from every general Intensive Care Unit in Scotland and almost all the High Dependency Units. It therefore provides a comprehensive representation of Critical Care in Scotland. While the report compares units it must be remembered that each unit admits a different spectrum of patients reflecting the variation in the type of clinical work between hospitals. This means that being different, especially in therapeutic activities, is to be expected and need not reflect standards of care.

The number of ICU and Combined Unit admissions in Scotland increased slightly last year and while the total number of HDU admissions increased (due to more units joining the audit) the like for like admissions to HDU were stable. The average occupancy rates for ICU/Combined Units and HDU continue to be around the ideal 75% level needed to service an unpredictable demand, but there continue to be some units which have higher occupancy rates.

The unpredictable nature of this service continues to be reflected in the high percentage of patients admitted out of hours (43% in ICU/Combined Units and 32% in HDU). It is also reflected in the number of early and out of hours discharges which are likely to be due to a short term increase in Critical Care demand. Out of hours discharges have been associated with poor outcomes and should be avoided\(^6\). There has been no reduction in the number of early or out of hours discharges in the last year.

A continued stress on Critical Care provision is the difficulty in transferring patients, who no longer need Critical Care, to wards; this may also contribute to out of hours discharges. This difficulty is largely due to a shortage of general ward beds and appears to be increasing over the years. It is also apparent that with the centralisation of service it may be difficult to arrange transport to return a patient who no longer needs specialist care, back to their local hospital.

While the majority of patients are admitted from theatre, the number of patients admitted from Emergency Departments to ICU and Combined Units now exceeds that admitted from hospital wards. Hopefully this is a sign that sick patients are being recognised earlier and appropriate management started earlier. There has been no change in the pattern of HDU admissions.

Differences in the patient mix across Critical Care units mean that real differences in use of interventions should be taken as descriptive, rather than indicating a qualitative difference, though they can be used as a benchmark for other units. There is no evidence of any overall change in the therapies recorded in the audit. Likewise there has been little change in the average level of care provided in both ICU/Combined Units and HDUs. In some units there are a surprisingly high number of patients who never require more than ward level care. There may be specific local reasons for this.

As in previous years SICSAG has used APACHE II to adjust for case mix differences in ICU outcomes\(^7\). The overall case mix adjusted mortality rate continues to slowly improve, although this is not statistically significant year on year. As last year, no unit appears to be significantly different from the others. Similar to last year there is one unit that may be different from the Scottish mean, but it is not the same unit. Experience in this and other audits suggests that, with the number of units in the audit, it is likely that one or two units will appear to be different at this level of significance due to chance. However if it is a chance effect the same unit will not always appear in this position. Over the years this is what we have found, units which have appeared different one year have not appeared so the next year. However we do not take the finding of possible differences lightly and such units are actively encouraged to examine their practice and data collection by contacting them before publication of this report.

Finally the data included in this report does not include all the work of SICSAG. In collaboration with Health Protection Scotland we collect data on Healthcare Associated Infection (HAI). This is reported separately but the initial pilot report\(^3\) suggests that the incidence of HAI in Scottish units is no higher than in other European countries and gives us a benchmark for future years. The information we collect is also used to support the work of the Scottish Patient Safety Programme.
Section 1  Activity

1.1 Number of admissions

This section details activity in Critical Care units. It includes data on admissions, occupancy and discharges and is presented in a variety of formats such as tables, line graphs, bar charts and funnel plots. Information on funnel plots is given in Appendix 4.2. When interpreting these charts it is very important to remember that there are real differences between ICU/Combined units and also between the HDUs. Patient case load, patient case mix, geographical location such as co-location may all account for any differences seen.

Figure 1  Annual admissions to ICU and Combined Units (2001-2010)

After reaching a peak in 2007 (10451) the number of admissions to ICU and Combined units (9802) is similar to last year.
The number of admissions to HDU continues to rise. A number of units completed their first full year of data as well as two Medical HDUs from Fife joining the audit (Queen Margaret and the Victoria Hospitals). Two other new units from the Western Infirmary in Glasgow and the Western General in Edinburgh started their data collection in November.

The cohort line is data from units that have the last six years worth of complete data.
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* HDU beds closed Nov 2010. No longer a combined ICU/HDU

Shaded areas refer to periods with incomplete data collection.

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* Stopped collecting audit data September 2010
** Unit joined audit February 2010
*** Unit joined audit November 2010

Shaded areas refer to periods with incomplete data collection.
1.2 Bed occupancy

**Figure 3** Bed occupancy rates for ICU and Combined Units (2010)

Bed occupancy for ICU and Combined Units is unchanged from last year. Unit X is above 3 Standard Deviations (SD) from the Scottish mean.

**Figure 4** Bed occupancy rates for HDU (2010)

The mean occupancy is higher than in previous years. For the fourth year in a row unit K2 has a significantly higher occupancy than other units. As last year unit AB1 again has a significantly lower occupancy rate.
### 1.3 Length of stay

#### Figure 5  Mean length of stay in ICU and Combined Units (2010)

The mean length of stay this year is 4.6 days, down slightly compared to last year. Unit M is below 2 SD from the mean.

#### Figure 6  Mean length of stay in HDU (2010)

The mean length of stay in HDU is similar to last year. Three units have a significantly longer length of stay. These are the same units as the previous two years. Unit W3 is a neurological HDU; the other two are surgical HDUs.
1.4 Timing of Critical Care admissions and discharges

Figure 7  Time of admission to ICU/Combined Units and HDU (2010)

The distribution of time of admission to Critical Care is unchanged from previous years. Both Intensive Care and High Dependency are 24 hour services. HDU has a higher elective workload but still admits almost a third (32%) of patients out of hours.
Unit U has a different out of hours admission profile to the other units in Scotland.

Overall, the HDU picture has remained similar over the last two years. Units G2 and R3 are above 3 SD from the mean. Although there have been some changes in the way we analyse and report these data, unit G2 has remained an outlier above 3 SD for the past 4 years now.
There has been no real change in the spread of out of hours discharges over the last year. Both units J and Q may be different. This is the second year running that unit Q is in this position. Unit W has a significantly lower rate than the rest of Scottish units.

The spread of out of hours discharges from HDU is wide, reflecting the varied nature of the units. Unit O3 is different to the rest of the HDUs.
1.5 Delayed discharges

These data are collected differently in the newest version of WardWatcher. The change in WardWatcher may explain the increase over the last 2 years although it is likely that the numbers for previous years were an underestimate. This year we report it as a percentage of all live unit discharges.

The number of discharges considered by staff to have been delayed, from ICU/Combined Units and HDU, continues to rise throughout Scotland. As for last year the most common reason recorded was lack of step-down beds. Over one quarter (28%) of all live ICU/Combined Unit discharges were deemed to have been delayed. It is not possible to judge the consequences of this and reasons should be investigated locally.

Figure 13 Reasons for delayed discharges in ICU and Combined Units (2010)
Figure 14 Reasons for delayed discharges in HDU (2010)

- Ward bed shortage: 91%
- HDU bed shortage: 3%
- Other: 2%
- Transport problems: 2%
- Nursing staff shortage: 1%
- ICU bed shortage: 1%
- Other staff shortage: <1%
Figure 15  Delayed discharges in ICU and Combined Units (2010)

Unit X is significantly different from the rest of Scotland.

Figure 16  Delayed discharges in HDU (2010)

Units Q2, R3, X2 and X3 are all above 3 SD. Two of these units are in the same hospital as unit X in Figure 15.

In unit X2 more than 50% of all live discharges are considered to be delayed, and the delay recorded is greater than 6 hours.
1.6 Early discharges

Figure 17 Early discharges from ICU and Combined Units (2010)

Note: In some circumstances transfer may not be in the best interest of the patient but necessary due to pressure on beds or staffing. This is defined as an early discharge.

Note: Units E and L overlap almost completely

Figure 18 Early discharges from HDU (2010)

Note: In some circumstances transfer may not be in the best interest of the patient but necessary due to pressure on beds or staffing. This is defined as an early discharge.

Note: Units G2 and Q2 overlap almost completely

Early discharge from Critical Care can be used as a marker of insufficient resources. These data are based on the clinical assessment of the person doing each discharge. This is now the second year we have reported these data and overall the pattern is similar to last year.
1.7 **Readmissions to Critical Care**

Readmissions to Critical Care may be an indicator that discharge was too early, or that downstream care was not of a sufficient standard.

**Figure 19** Readmissions within 48 hours of discharge to ICU and Combined Units (2010)

Overall the mean readmission rate in Critical Care in Scotland is very low at less than 1.5%. Unit W (Figure 19) is significantly different.
1.8 Source of admission

**Figure 21  Source of admissions to ICU and Combined Units (2001-2010)**

For the first time, the number of patients admitted from Emergency Departments to ICU/Combined Units now exceeds that admitted from hospital wards.

**Figure 22  Source of admissions to HDU (2005-2010)**

There has been little relative change in the pattern of HDU admissions.
1.9 Chronic health

The Acute Physiology and Chronic Health Evaluation (APACHE II) scoring system used in this audit calculates a predicted mortality for each patient that is compared to the actual mortality, to give the Standardised Mortality Ratio (SMR) used in outcome reporting (page 27). The predicted mortality is calculated from the APACHE II score in combination with a diagnostic category. In turn, the APACHE II score is made up of age and acute physiology points. Points are added for those with one or more chronic health conditions, two for elective surgical patients and five for non-operative or emergency post-operative patients. There are precise criteria for defining the presence of chronic organ conditions. These criteria are built into WardWatcher with on screen prompts to encourage accurate data entry.

Figure 23 Chronic health conditions recorded in ICU and Combined Units (2005 – 2010)

The breakdown of conditions over time is shown in Figure 23 and has changed little. Separate bars are shown for 2009 and 2010 to include those who have imaging proven hepatic cirrhosis. More patients are admitted with imaging proven hepatic cirrhosis than biopsy proven cirrhosis. This reflects a change in the usual method of diagnosis of this condition since the APACHE II study was published in 1985. Assuming that the effect of the diagnosis on mortality has not changed, it would seem prudent to accept imaging proven cirrhosis as a chronic health condition in future as it currently does not add any points to the overall APACHE II score.
The mean incidence of those with chronic health conditions in Scottish ICUs and Combined Units is 18.2%. The spread across Scotland is relatively even, though unit X is significantly different. This unit treats a large number of patients with chronic liver disease which may explain this finding.
1.10 Organ Donation

Figure 25 Scottish deceased organ donors (2000-2011)

Note: donation after brain stem death (DBD); donation after cardiac death (DCD)

*Source: data from NHS Blood and Transplant

Overall numbers of deceased organ donors remain steady with some variation year to year. There has been an increase in donation after cardiac death (DCD) in recent years.
Of the total referrals for organ donation, family refusal and declined referrals form a significant proportion. Procurator Fiscal refusals are however rare. These figures will not include cases where the Specialist Nurse for Organ Donation was never notified as the intensive care staff decided that the potential donor was unsuitable or the family had already refused donation. NHS Blood and Transplant would encourage clinicians to notify the Specialist Nurse for Organ Donation in all cases of possible organ donation in line with the document ‘Organs for Transplant’ from the Organ Donation Taskforce 20089.

*Source: data from NHS Blood and Transplant*
Section 2 Interventions in Critical Care

The 2010 interventions section is from data collected in the WardWatcher Augmented Care Period (ACP) screen. This year is the first complete year of data collected with the new upgraded version of WardWatcher. This allows direct and meaningful comparison between units of interventions carried out in Critical Care areas.

2.1 Respiratory Support

This year’s report shows very little change in the percentage of episodes with invasive ventilation, at any time, in Scottish ICUs and Combined Units remaining at nearly 70%. H1N1 did not seem to have the impact that the meticulous planning had been concerned about. Unit N was the only unit to be above 3 SD - performing invasive ventilation on over 90% of their admissions.
The use of Non Invasive Ventilation (NIV) & Continuous Positive Airway Pressure (CPAP) in ICU is well established. The Scotland-wide incidence has fallen again this year to 8.5%. This may reflect a change in the way the data is collected on the Augmented Care Period (ACP) screen of the new version of WardWatcher or it may reflect a change in practice.

Unit R remains an outlier above 3 SD and this may be related to it being the regional centre for home ventilation assessment.

The incidence of NIV/CPAP in HDU has increased slightly this year. Units X2 and H2 remain outliers above 3 SD.
2.2 Cardiovascular Support

Figure 30 Use of vasoactive and/or antiarrhythmic drugs in ICU and Combined Units (2010)

There has been little change in the use of vasoactive and/or antiarrhythmic drugs in Scottish ICUs although the Combined Units tend to have a lower usage.

Figure 31 Use of vasoactive and/or antiarrhythmic drugs in HDU (2010)

The use of vasoactive and/or antiarrhythmic drugs in HDUs in Scotland is 10% - only a slight increase on last year. There remains considerable variation across Scotland indicating the diversity of HDU admissions and specialities.
The use of cardiac output monitoring is an important tool in the management of the critically ill patient. Only units N and D remain above 3 SD. The number of episodes with cardiac output monitoring at any time in Unit D has increased from 32% to 43%. There is a wide variation in use between units with outliers both above and below 3 SD.
2.3 Renal Support

Figure 33 Renal Replacement Therapy (RRT) in ICU and Combined Units (2010)

The proportion of patients receiving Renal Replacement Therapy in Scottish ICUs has not changed for the past 3 years at approximately 12%.
2.4 Level of Care

**Figure 34** Highest level of care in ICU and Combined Units (2010)

As in previous reports, data collected via the ACP screen of WardWatcher has enabled us to define patients’ level of care. This information allows resource planning to be accurately predicted based on previous years data. This year the units are ranked in descending order from the most frequent episodes of highest care downwards. Similar to last year, the percentage of patients in Scottish units that require level 3 care is high - 80%- indicating the significant resource implications and skill mix faced by each unit.

**Figure 35** Highest level of care in HDU (2010)

The HDU level of care is similar to last year. It shows a wide variation with nearly 14% of the patients requiring level 3 care. Reassuringly the majority appear to be at the appropriate level of care (level 2). There are still significant numbers of patients at level 1 or level 0 care (ward care).
This funnel plot is a new addition and reports on the percentage of patient days spent at level 3 in ICU and Combined Units. It represents a significant workload throughout all Scottish units - over 70% of patient days are spent at the maximum level of care (level 3). There are no outliers above 3 SD but units U and S have a significantly lower percentage of patient days at level 3 compared with the mean.
Section 3  Outcomes

Figure 37  Crude mortality of patients with mortality predictions in ICU and Combined Units (2001-2010)

The crude mortality for all patients admitted to ICU in Scotland over the past 10 years is shown in Figure 37. Patient mortality in ICU continues to fall and is now 8.6 percentage points below the mortality rates recorded in 2001.

In 2010 17.7% of all patients admitted to intensive care died in the unit, 6.3% died following ICU discharge but before hospital discharge and 1% died before ultimate hospital discharge.

In summary, in 2010 25% of all patients admitted to ICU in Scotland died before their ultimate hospital discharge. This equates to 2057 patient deaths in 2010.

Figure 38  Case mix adjusted SMRs in ICU and Combined Units (2001-2010)

The improvements in crude mortality may be explained by changes in patient population. Adjustment for case mix will remove this uncertainty and the graph above shows an improvement in outcomes. For
records recorded using the new version of Ward Watcher from mid 2008 onwards, the mortality predictions have now been adjusted to remove any APACHE II points based on the pre-sedation GCS. This allows a valid comparable analysis of SMR trends between the years 2001 to 2010. One result of this correction is a slight upward adjustment in the overall Scottish SMR produced in 2008 and 2009. The SMR of 0.86 for 2010 continues the downward trend and is the lowest yet recorded. Outcomes are now more complete for the earlier years of this graph compared with that published in the 2010 annual report. This reflects the ongoing emphasis on data quality improvement and accuracy within SICSAG & ISD and the commitment to re-analyse and clean up the dataset produced in previous years.

Comment on Funnel Plots for Standardised Mortality Ratios

SICSAG will always highlight units outside 2 SD from the mean as “might be different” and outside 3 SD as “are different”. It should be recognised that comparison of 24 units has a considerable chance of an outlier at the 2 SD (approximately 5% or 1 in 20) level.

Over the time that the audit has been in existence, various units have been outliers at 2 SD level. We have sought reasons as to why they might be different and informed and supported individual units in seeking an explanation. No unit has been a consistent outlier over years. Being an outlier at this level may be explained by data quality, questions over standards of care, different referral patterns, admission policies or resources but it also may be a chance finding. Therefore, we are using a very stringent definition of variance. For comparison, mortality rates produced for the Scottish Surgical Profiles, by ISD, will use 3 SD level to identify outliers.

Figure 39  Standardised Mortality Ratios in ICU and Combined Units (2010)

This funnel plot shows the SMR for ICU and Combined Units. In this annual report there are no units with outcome measures above 3 SD. The grouping of units around the mean SMR of 0.86 remains relatively uniform when compared to the reports published in previous years. Three units lie outside 2 SD. Unit W lies above 2 SD and units C and U lie below 2 SD.
We continue to produce the SMR funnel plot using pre-sedation GCS as additional information is gained in this representation. While the overall SMR falls (as would be expected) the distribution of units is similar. Unit W remains an outlier above the 2 SD line.

![Figure 40 Standardised Mortality Ratios with pre-sedation GCS in ICU and Combined Units (2010)](image)

Figure 41 shows the SMR, with pre-sedation GCS, for non-operative patients admitted to ICU and Combined Units. These patients generally have a worse outcome as they do not have a surgically remedial problem leading to ICU admission following operative intervention. The SMR is correspondingly slightly higher at 0.88. In 2010 all units were within the 2 SD control limits.

![Figure 41 Standardised Mortality Ratios with pre-sedation GCS for non-operative patients in ICU and Combined Units (2010)](image)
Those patients admitted to ICU following operative intervention have a lower SMR. Once adjusted for pre-sedation, the Scottish SMR is 0.61 for this cohort of patients compared to 0.8 for all patients and 0.88 for non-operative patients. Four units are outliers. Units M, C and H are below the 2 SD line and unit W is above the 2 SD line.
Conclusions

The information contained in this report is encouraging. Most importantly, there has been a continued small but steady improvement in the number of patients surviving ICU in Scotland. Uniquely among other national audits it covers all the ICUs and Combined Units in Scotland and a high and increasing percentage of HDUs, thus the information contained here is representative of Scottish Critical Care. The report therefore gives confidence to local communities that there are no poorly performing ICUs or Combined Units in Scotland.

However, there are still challenges. The changing pattern of health service provision and increased ward bed utilization means that limited Critical Care beds are occupied by ward level patients, and that more patients are discharged out of hours. This has implications for both emergency patients and planned admissions (usually for elective surgery).

The full effects of changes in medical training have yet to work through the system and the reducing number of trainees will put stress on staffing of units. In the future this audit will, hopefully, provide evidence that these changes have not had an adverse effect on clinical care.
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<td>ICU Level 3</td>
<td>Combined ICU/ HDU Level 3/2</td>
<td>HDU Level 2/1</td>
<td>Specialised Units</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------</td>
<td>-----------------------------</td>
<td>---------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>RIE</td>
<td></td>
<td>13/5</td>
<td>10 HDU</td>
<td>6 + 2 Renal/ HDU</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>4 Vascular Level 1</td>
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<td>3.2/1.8</td>
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<tr>
<td>WGH</td>
<td></td>
<td>9/7</td>
<td>10 SHDU (Level1)</td>
<td>4 Neurological HDU</td>
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<td></td>
<td></td>
<td>3 Neurological Level 1</td>
</tr>
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<td></td>
<td>Oct 2010</td>
</tr>
<tr>
<td>GBH, Shetland</td>
<td></td>
<td></td>
<td></td>
<td>1 HDU**</td>
</tr>
<tr>
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<td>7.5</td>
<td>10 SHDU</td>
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<td></td>
<td></td>
<td></td>
<td>6 MHDU</td>
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</tr>
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<td>PRI</td>
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<td>3</td>
<td>4 HDU</td>
<td></td>
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<tr>
<td>W. Isles, Stornoway</td>
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<td></td>
<td></td>
<td></td>
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<td>Balfour Hospital,</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Orkney</td>
<td></td>
<td></td>
<td></td>
<td>HDU data in 2011</td>
</tr>
</tbody>
</table>

Includes units participating in SICSAG only

Key:
- HDU: Combined Medical/Surgical HDU
- MHDU: Medical HDU
- SHDU: Surgical HDU

Note: Changes, or new units to audit, in 2010 are shown in red; Units joining in 2011 in blue

* Predominantly Surgical HDU but does admit medical patients. **Not separately funded
Location of Critical Care Units in Scotland

<table>
<thead>
<tr>
<th>Health Board</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater Glasgow &amp; Clyde</td>
<td>1,194,675</td>
</tr>
<tr>
<td>Lothian</td>
<td>817,727</td>
</tr>
<tr>
<td>Lanarkshire</td>
<td>561,174</td>
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<td>Grampian</td>
<td>539,630</td>
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<tr>
<td>Tayside</td>
<td>396,942</td>
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<tr>
<td>Ayrshire &amp; Arran</td>
<td>367,510</td>
</tr>
<tr>
<td>Fife</td>
<td>361,815</td>
</tr>
<tr>
<td>Highland</td>
<td>309,900</td>
</tr>
<tr>
<td>Forth Valley</td>
<td>290,047</td>
</tr>
<tr>
<td>Dumfries &amp; Galloway</td>
<td>146,580</td>
</tr>
<tr>
<td>Borders</td>
<td>112,430</td>
</tr>
<tr>
<td>Western Isles</td>
<td>26,200</td>
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<tr>
<td>Shetland Islands</td>
<td>21,980</td>
</tr>
<tr>
<td>Orkney Islands</td>
<td>19,890</td>
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Appendix 1  Data Quality in ICU/Combined Units and HDUs

A high standard of data quality is essential in order for critical care staff to feel confident to use SICSAG data to inform changes necessary in order to improve quality and service provision. The data quality processes undertaken by SICSAG are incorporated into 2 main processes:

1. The monthly case-note validations undertaken by the local and regional audit co-ordinators.
2. The routine WardWatcher data quality assurance process carried out at the point of data entry, and centrally once the local data is extracted.

<table>
<thead>
<tr>
<th>Scotland total</th>
<th>Time Period</th>
<th>Number of validations</th>
<th>Comparisons</th>
<th>Agreement</th>
<th>Disagreement</th>
<th>Data not yet entered/not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU/Combined Units</td>
<td>Jan – May 2010</td>
<td>479</td>
<td>10538</td>
<td>84%</td>
<td>6%</td>
<td>10%</td>
</tr>
<tr>
<td>High Dependency Units</td>
<td>Aug – Dec 2010</td>
<td>486</td>
<td>7290</td>
<td>85%</td>
<td>4%</td>
<td>11%</td>
</tr>
</tbody>
</table>

Data from the admission, history, severity, and Augmented Care Period (ACP) pages of WardWatcher (WW) were prospectively validated by comparing data in WW with data in the case-notes. In HDU severity data is not collected, therefore could not be validated.

The main outcome measure was the level of agreement. When the data taken from the case notes was the same as the recordings in WW, the two sources of information were in agreement. When the data taken from the case-notes was different from the recordings in WW, the two sources of information were in disagreement. When information was documented in the case-notes but not recorded in WW it was recorded as not yet entered.

The results indicate that the data quality measured is of a very high standard, with only a 6% level of disagreement in ICU and Combined Units, and a 4% level of disagreement in HDU.

Figure A1 and Table A2 (page 36) and Figure A2 and Table A3 (page 37) provide a further breakdown of data validated.
Figure A1: Data quality in ICU and Combined Units (January – May 2010)

Table A2: Data quality in ICU and Combined Units (January – May 2010)

<table>
<thead>
<tr>
<th>Data item</th>
<th>Number of validations</th>
<th>Agree</th>
<th>Disagree</th>
<th>Not yet entered/ not applicable</th>
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<tr>
<td>Temperature</td>
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<td>386</td>
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<tr>
<td>Sodium</td>
<td>479</td>
<td>375</td>
<td>45</td>
<td>59</td>
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<tr>
<td>Respiratory rate</td>
<td>479</td>
<td>360</td>
<td>64</td>
<td>55</td>
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<tr>
<td>Respiratory ACP</td>
<td>479</td>
<td>461</td>
<td>8</td>
<td>9</td>
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<tr>
<td>Readmission</td>
<td>479</td>
<td>446</td>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>Potassium</td>
<td>479</td>
<td>375</td>
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<td>59</td>
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<tr>
<td>Postcode</td>
<td>479</td>
<td>455</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>PMH - Correct</td>
<td>479</td>
<td>425</td>
<td>8</td>
<td>46</td>
</tr>
<tr>
<td>Nature of Surgery</td>
<td>479</td>
<td>312</td>
<td>3</td>
<td>164</td>
</tr>
<tr>
<td>Lowest pO2</td>
<td>479</td>
<td>376</td>
<td>43</td>
<td>60</td>
</tr>
<tr>
<td>Lowest GCS</td>
<td>479</td>
<td>364</td>
<td>64</td>
<td>51</td>
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<tr>
<td>Lowest Diastolic BP</td>
<td>479</td>
<td>403</td>
<td>22</td>
<td>54</td>
</tr>
<tr>
<td>Highest Systolic BP</td>
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<td>394</td>
<td>31</td>
<td>54</td>
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<td>Heart rate</td>
<td>479</td>
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<td>44</td>
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<td>Haemoglobin</td>
<td>479</td>
<td>366</td>
<td>47</td>
<td>66</td>
</tr>
<tr>
<td>Evidence PMH</td>
<td>479</td>
<td>426</td>
<td>15</td>
<td>38</td>
</tr>
<tr>
<td>CPR prior</td>
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<td>446</td>
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<td>27</td>
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<tr>
<td>Corresponding PH/H+ion</td>
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<td>349</td>
<td>69</td>
<td>61</td>
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<td>CHI No</td>
<td>479</td>
<td>445</td>
<td>8</td>
<td>25</td>
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<tr>
<td>Admitted from</td>
<td>479</td>
<td>472</td>
<td>7</td>
<td>0</td>
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<tr>
<td>Admission Time</td>
<td>479</td>
<td>467</td>
<td>10</td>
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<td>Admission date (hospital)</td>
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<td>413</td>
<td>29</td>
<td>37</td>
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Figure A2: Data quality in High Dependency Units (August – December 2010)

Table A3: Data quality in High Dependency Units (August – December 2010)

<table>
<thead>
<tr>
<th>Data item</th>
<th>Number of validations</th>
<th>Agree</th>
<th>Disagree</th>
<th>Not yet entered/ not applicable</th>
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</thead>
<tbody>
<tr>
<td>Single vasoactive</td>
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<td>457</td>
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<td>Readmission</td>
<td>486</td>
<td>423</td>
<td>16</td>
<td>47</td>
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<tr>
<td>Postcode</td>
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<td>469</td>
<td>11</td>
<td>6</td>
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<td>18</td>
<td>192</td>
</tr>
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<td>459</td>
<td>2</td>
<td>25</td>
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<td>Nature of Surgery</td>
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<td>291</td>
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<td>182</td>
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<td>85</td>
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<td>440</td>
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<td>45</td>
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<td>Complex dressings</td>
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<td>27</td>
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<td>CHI No</td>
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<td>9</td>
<td>13</td>
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<td>Cardiac</td>
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<td>448</td>
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<td>38</td>
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<td>Admitted from</td>
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<td>475</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Admission Time</td>
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<td>418</td>
<td>59</td>
<td>9</td>
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<tr>
<td>Admission date (hospital)</td>
<td>486</td>
<td>392</td>
<td>46</td>
<td>48</td>
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### Appendix 2  ICU Unit Profiles 2011

#### Part 1: Capacity and Multi-disciplinary Team Information

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<thead>
<tr>
<th>Hospital</th>
<th>Actual beds</th>
<th>Funded beds (Level 3/2)</th>
<th>Trained nursing WTE/level 3 bed</th>
<th>ICU pharmacist</th>
<th>Daily contact from microbiologist</th>
<th>Daily physiotherapy review</th>
<th>Dietitic review for all patients</th>
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<td>4</td>
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<td>3/2</td>
<td>5.50</td>
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<td>Yes</td>
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<td>DGRI</td>
<td>6</td>
<td>4</td>
<td>5.69</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>QMH</td>
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<td>6.89</td>
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<td>12</td>
<td>7.00</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
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<td>20</td>
<td>12/8</td>
<td>5.54</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>IRH</td>
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<td>3</td>
<td>Staff shared between ICU/CCU/HDU</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
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<td>5.93</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>6.68</td>
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<td>6.55</td>
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<td>Yes</td>
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<td>Hospital</td>
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<td>Weekend ward rounds done by ICM Consultant</td>
<td>Source of trainees</td>
<td>Trainees cover other areas</td>
<td>Training Advanced Critical Care Practitioners</td>
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<td>--------------</td>
<td>--------------------------------------------</td>
<td>---------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
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<tr>
<td>AYR</td>
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<td>No</td>
<td>Anaesthesia; ACCS; Acute Medicine; Emergency Medicine</td>
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<td>Yes</td>
<td>Anaesthesia; ACCS</td>
<td>Yes - theatres out of hours</td>
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<td>BGH</td>
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<tr>
<td>DGRI</td>
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<td>Yes</td>
<td>Anaesthesia</td>
<td>Yes out of hours</td>
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<tr>
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<td>Anaesthesia; ACCS; FY1; FY2</td>
<td>Out of hours: 2 anaesthetists covering critical care, theatre, labour ward.</td>
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<td>Anaesthesia; ACCS</td>
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<td>Yes - theatres</td>
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<td>No</td>
<td>Anaesthesia; Foundation Year.</td>
<td>Yes</td>
<td>No</td>
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<td>Hairmyres</td>
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<td>No</td>
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<td>Yes - theatre out of hours</td>
<td>Yes</td>
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<tr>
<td>MDGH</td>
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<td>Yes</td>
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<td>Yes</td>
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<td>Wishaw</td>
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<td>No</td>
<td>Anaesthesia; ACCS; FY1</td>
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## Part 2: Medical Staff Information

<table>
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<tr>
<th>Hospital</th>
<th>Weekday ward rounds done by ICM Consultant</th>
<th>Weekend ward rounds done by ICM Consultant</th>
<th>Source of trainees</th>
<th>Trainees cover other areas</th>
<th>Training Advanced Critical Care Practitioners</th>
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<tr>
<td>RIE</td>
<td>Yes</td>
<td>Yes</td>
<td>FY2; ST1-2 Anaesthesia; ACCS Anaesthesia; Acute Medicine; Emergency Medicine; ST4; ST3-7 Anaesthesia; ST3-7 Anaesthesia of ICM training</td>
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<td>No</td>
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<td>Yes out of hours For specialist module</td>
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<tr>
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<td>Yes</td>
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<tr>
<td>Ninewells</td>
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<td>Anaesthesia; ACCS; Acute Medicine; Emergency Medicine</td>
<td>No</td>
<td>No</td>
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<td>Yes</td>
<td>Yes</td>
<td>Anaesthesia; ACCS; FY2</td>
<td>Yes - theatres out of hours and part of the hospital at night team</td>
<td>No</td>
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### Part 3: Quality Improvement Measures (snap shot only)

<table>
<thead>
<tr>
<th>Hospital</th>
<th>MDT ward round - days/week</th>
<th>MDT ward round attendees</th>
<th>Frequency of M &amp; M meetings</th>
<th>M &amp; M attendees</th>
<th>Type of incident reporting</th>
<th>Data to SPSP</th>
<th>Type of care bundle</th>
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</thead>
<tbody>
<tr>
<td>AYR</td>
<td>5</td>
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<td>Quarterly departmental meetings</td>
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<td>Yes</td>
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<td>Medical; Nursing; Physiotherapy; Microbiology; Occasionally referring physician / surgeon</td>
<td>Datix and paper based clinical incident reporting</td>
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<td>Datix</td>
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<td>Monthly</td>
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<td>7</td>
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<td>Datix and in house system</td>
<td>Yes</td>
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<td>Datix</td>
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<td>Datix</td>
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## Part 3: Quality Improvement Measures (snap shot only)

<table>
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<th>Hospital</th>
<th>MDT ward round - days/week</th>
<th>MDT ward round attendees</th>
<th>Frequency of M &amp; M meetings</th>
<th>M &amp; M attendees</th>
<th>Type of incident reporting</th>
<th>Data to SPSP</th>
<th>Type of care bundle</th>
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<tr>
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<td>Medical; Nursing; Micro-biology; Physio-therapy; Dietetics</td>
<td>Datix</td>
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<td>VAP; CVC insertion &amp; maintenance; Sepsis; DKA; Therapeutic hypothermia</td>
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<td>Medical; Nursing</td>
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<td>Datix</td>
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<td>Datix</td>
<td>Yes</td>
<td>VAP; CVC insertion &amp; maintenance; PVC</td>
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<tr>
<td>Raigmore</td>
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<td>Medical; Nursing; Microbiology; Physiotherapy; Dietetics</td>
<td>Monthly</td>
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<td>Voluntary critical incident reporting within the unit to supplement Datix</td>
<td>Yes</td>
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<td>Critical incident reporting</td>
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<td>VAP; CVC insertion &amp; maintenance; PVC</td>
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<td>Medical; Nursing; Microbiology; Physiotherapy</td>
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<td>Datix</td>
<td>Yes</td>
<td>VAP; CVC; PVC; Arterial line</td>
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<td>Medical; Nursing; Students</td>
<td>Datix</td>
<td>Yes</td>
<td>VAP; CVC; PVC; Blood cultures</td>
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### Part 3: Quality Improvement Measures (snap shot only)

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<th>Hospital</th>
<th>MDT ward round - days/week</th>
<th>MDT ward round attendees</th>
<th>Frequency of M &amp; M meetings</th>
<th>M &amp; M attendees</th>
<th>Type of incident reporting</th>
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<th>Type of care bundle</th>
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<td>SJH</td>
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<td>VAP; CVC insertion &amp; maintenance; PVC</td>
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<td>Datix</td>
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<td>VAP; CVC insertion &amp; maintenance; PVC</td>
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<td>IR-1; Royal College of Anaesthetist</td>
<td>Yes</td>
<td>VAP; Daily goals; Blood sugar control; weaning algorithms</td>
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### Part 1: Capacity and Multi-disciplinary Team Information

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Funded Level 2/1 beds</th>
<th>Trained nursing WTE/Level 2 bed</th>
<th>Dedicated HDU consultant - days/week</th>
<th>Dedicated HDU pharmacist</th>
<th>Microbiologist - daily contact</th>
<th>Physiotherapy review - daily</th>
<th>Dietetic review for all patients</th>
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<tr>
<td>Ayr HDU</td>
<td>4</td>
<td>3.02</td>
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<td>Yes</td>
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<td>2.45</td>
<td>0</td>
<td>Yes</td>
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<td>Yes</td>
<td>Yes</td>
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<tr>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>DGRI Medical HDU</td>
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<td>3.15</td>
<td>0</td>
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<td>Not weekends unless requested</td>
<td>If referred</td>
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<td>Dr Gray’s HDU</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>If referred</td>
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### Part 1: Capacity and Multi-disciplinary Team Information

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<th>Hospital</th>
<th>Funded Level 2/1 beds</th>
<th>Trained nursing WTE/Level 2 bed</th>
<th>Dedicated HDU consultant - days/week</th>
<th>Dedicated HDU pharmacist</th>
<th>Microbiologist - daily contact</th>
<th>Physiotherapy review - daily</th>
<th>Dietetic review for all patients</th>
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<td>No</td>
<td>Yes</td>
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<td>If referred</td>
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<td>Dedicated HDU pharmacist</td>
<td>Microbiologist - daily contact</td>
<td>Physiotherapy review - daily</td>
<td>Dietetic review for all patients</td>
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<td>RIE Vascular (Level 1)</td>
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<td>No</td>
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<td>No</td>
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<td>GBH HDU</td>
<td>2 beds, not separately funded. (Part of surgical ward)</td>
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<td>5 1/2 days (mornings only)</td>
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<td>If referred</td>
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<td>No</td>
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## Part 2: Quality Improvement Measures (snap shot only)

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<th>Hospital</th>
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<th>MDT ward round attendees</th>
<th>M &amp; M meetings - frequency</th>
<th>M &amp; M attendees</th>
<th>Type of incident reporting</th>
<th>Data to SPSP</th>
<th>Type of care bundle</th>
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<td>Medical; Nursing</td>
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<td>n/a</td>
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<td>n/a</td>
<td>Weekly</td>
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<td>No</td>
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<td>n/a</td>
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<td>n/a</td>
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<td>5 days/week</td>
<td>Medical; Nursing; Physiotherapy; Occupational Therapy, Speech &amp; Language Therapy</td>
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<td>n/a</td>
<td>Datix</td>
<td>No</td>
<td>n/a</td>
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<tr>
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<td>n/a</td>
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<td>Datix</td>
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<td>Monthly</td>
<td>Medical staff</td>
<td>Datix</td>
<td>Yes</td>
<td>PVC; SBAR; Daily patient goals</td>
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## Part 2: Quality Improvement Measures (snap shot only)

<table>
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<tr>
<th>Hospital</th>
<th>MDT ward round - days/week</th>
<th>MDT ward round attendees</th>
<th>M &amp; M meetings - frequency</th>
<th>M &amp; M attendees</th>
<th>Type of incident reporting</th>
<th>Data to SPSP</th>
<th>Type of care bundle</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRH Surgical HDU</td>
<td>No</td>
<td>0</td>
<td>Monthly</td>
<td>Medical staff</td>
<td>Datix; Critical incident</td>
<td>Yes</td>
<td>CVC; PVC; Sbar; Daily goals; Hand Hygiene</td>
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<tr>
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<td>Medical; Nursing</td>
<td>Monthly</td>
<td>Surgical M &amp; M Medical staff only. Medical M &amp; M Medical and Nursing staff</td>
<td>Datix</td>
<td>Yes</td>
<td>CVC; PVC; SBar; Hand Hygiene, Multi-Disciplinary Rounds; Safety Briefs; Daily Goals</td>
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<td>n/a</td>
<td>Monthly</td>
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<td>Datix</td>
<td>Yes</td>
<td>CVC insertion and maintenance; Daily goals; Sbar; PVC; Hand hygiene</td>
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<td>No</td>
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<td>n/a</td>
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<td>MDT ward round attendees</td>
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<td>M &amp; M attendees</td>
<td>Type of incident reporting</td>
<td>Data to SPSP</td>
<td>Type of care bundle</td>
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<td>n/a</td>
<td>Datix</td>
<td>Yes</td>
<td>CVC insertion and maintenance; PVC; Arterial lines</td>
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<td>No</td>
<td>n/a</td>
<td>Datix</td>
<td>Yes</td>
<td>CVC; PVC</td>
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<td>Monthly</td>
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<td>Yes</td>
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<td>RIE Transplant HDU</td>
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<td>Medical; Nursing; Pharmacist</td>
<td>Monthly</td>
<td>All MDT as able</td>
<td>Datix</td>
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<td>Monthly</td>
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<td>CVC; PVC; MUST; Name band; Falls; CDiff; SEWS; Discharge; Daily goals</td>
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<td>n/a</td>
<td>Weekly</td>
<td>Medical staff</td>
<td>Datix</td>
<td>Yes</td>
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<td>Medical; Nursing; Physiotherapy</td>
<td>Monthly</td>
<td>Medical staff</td>
<td>Datix</td>
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<td>PVC; CVC; SEWS.</td>
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<tr>
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<td>MDT ward round attendees</td>
<td>M &amp; M meetings - frequency</td>
<td>M &amp; M attendees</td>
<td>Type of incident reporting</td>
<td>Data to SPSP</td>
<td>Type of care bundle</td>
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</tr>
<tr>
<td>GBH HDU</td>
<td>7 days/week</td>
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<td>Monthly</td>
<td>Medical; Nursing; Pharmacy; Physiotherapy</td>
<td>Datix, and written complications journal.</td>
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<td>VAP; CVC; PVC; Hand hygiene</td>
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Appendix 4  Methodology

4.1  Data collection

Data were collected prospectively from all general adult ICUs, Combined Units and the majority of HDUs using the WardWatcher system developed for this purpose. In March 2011, an initial extract of 2010 data was sent to ISD servers. Validation queries relating to discharges, outcomes, ages and missing treatment information were then issued and fed back to individual units for checking by local and regional audit coordinators. A final validated extract was submitted to ISD in April 2011, which has been used for this report.

Along with the measures taken to ensure data validity, the comprehensiveness of the data (incorporating data on all admissions to participating units during 2010) ensures that the findings included in this report have a high degree of reliability at the national, health board and individual unit level.

4.2  Presentation of the Data

Data presented in this report are for patients receiving care in a participating ICU, Combined Unit or HDU between January 1st 2010 and December 31st 2010.

The analysis of these data and the presentation of the findings were broadly based on that adopted in previous annual reports. However, a few significant differences should be noted.

New analyses for ICUs, Combined Units and HDUs examine the percentage of live discharges which were delayed by at least six hours. Additional analyses address, for ICUs and Combined Units, the percentage of patient days where the patient received level 3 care.

This report includes 6 years of data from HDUs and therefore trends are becoming more apparent.

Additional tables, along with more detailed data on subject areas that are not included in this report, are available on the SICSAG website www.sicsag.scot.nhs.uk. Further information on the interpretation of funnel plots is also published on this website.

In 2009 and 2010, historical SICSAG data from 1995 to 2008 was linked to other datasets held within Information Services Division (ISD): SMR01 (General/acute inpatient and day cases); SMR6 (Cancer registrations); SMR4 (Mental Health) and Registrar General’s death records. All patients recorded in the SICSAG databases should also have a SMR01 record relating to the same hospital episode. This gives an alternative source of information on Hospital Outcome and Ultimate Hospital Outcome. Where the value of this field was not documented in SICSAG, it has been overwritten with the value derived from linkage to SMR01. This has improved the completeness of the historic data for these fields.

In addition, an extensive review of the historical databases has been undertaken, missing data have been input and consistent analytical methods have been applied. This means that trend analyses contained within this report differ slightly from those included in past reports. Further review work will be carried forward into 2011/2012, with the aim of creating a rationalised set of databases which can be used for efficient analysis. The SICSAG database should be regarded as dynamic and ongoing validation of data may mean that the data is subject to change.

WardWatcher was upgraded in all units during 2008/2009 and some changes to the data set were made. 2010 is the first complete year of data based on the upgraded version of WardWatcher. Please refer to the 2009 Report11, available on the website www.sicsag.scot.nhs.uk for information on when hospitals were upgraded.
Funnel Plots

A number of the clinical indicators within this report are presented in graphs called control charts. A control chart is a simple way of presenting data that can help guide quality improvement activities, by flagging up areas where there appears to be marked variation and where further local investigation might be beneficial. Control charts have been used widely in the manufacturing industry, and have more recently been applied in healthcare settings. While the presentation of clinical indicators as league tables is advised against, the use of control charts has become increasingly popular.

Within this report funnel plots (a type of control chart) have been used to allow comparisons to be made between different services providers, in this case Critical Care Units.

A performance indicator is shown on the y-axis, while generally the number of admissions is shown on the x-axis. There is a data point for every unit in the funnel plot.

There are five key lines in the funnel plots used in this report. The first is the average for the type of Critical Care Unit (either ‘ICU or Combined Units’ or ‘HDU’). Plotted on either side of the average are two sets of warning limits. Warning limits are plotted at 2 and 3 standard deviations from the mean. Each of the five key lines are depicted in red on the charts.

Data points within the control limits (the red lines) are said to exhibit common cause variation or to be ‘in control’. Data points outwith the control limits are said to exhibit something called ‘special cause variation’ (sometimes referred to as ‘outliers’).

SICSAG will always highlight units outside 2 standard deviations from the mean as “might be different” and outside 3 standard deviations as “are different”. Differences may arise from many sources: differences in data accuracy, case-mix, service provision or practice. Sometimes a difference will be just a random difference caused by chance alone. SICSAG would encourage readers to use the data to examine practice in the context of the factors listed.

For some performance indicators, more than a few units are outside the outer control limits. This typically arises when the units are heterogeneous, for instance ICU versus Combined Units, or Surgical versus Medical HDUs. Then small institutional factors contribute to more variability than would be expected by chance alone. These differences may not be particularly important nor point to real differences in the performance indicators. Although the positions of the units differ in the statistical sense, they might not be of any clinical significance.

To account for excess variability the control limits can be adjusted in several ways. In this report they are calculated with a procedure derived from Spiegelhalter12.
4.3 APACHE II

The outcome measure used by SICSAG is the patients' survival status (alive or dead) when they finally leave hospital (even if this is not the original hospital). Patients admitted to ICU are at significant, but varied, risk of death. Simply comparing the proportion of patients who die in each unit can give a misleading impression because the severity of their illnesses is different. To overcome this, we use the APACHE II system to adjust for case-mix\(^7\). This is a validated scoring system\(^13\), which takes account of both the patients' acute condition and their chronic health.

Certain groups of patients are excluded:

- Less than 16 years of age
- Unit stay less than 8 hours
- Readmitted to unit during the same hospital admission
- Primary diagnosis for which the system was not developed: burns, coronary artery bypass graft, and liver transplant.

WardWatcher provides similar codes as reasons for excluding unit admissions from APACHE II scoring. Taking into account non-response, these were re-coded to reflect the hierarchy of decision-making within units. Automatic exclusions such as 'diagnosis', 'patient under 16' and 'patient stayed for less than eight hours' were excluded first and existing codes changed to reflect this prioritisation. Readmissions were excluded next, followed by 'other' cases where no rationale for automatic exclusion was provided. The remaining exclusions were optional, where it was possible to generate a score but this was not done (eg HDU patients).

If unit admissions are scored, case-mix adjusted mortality estimates may only be calculated in cases where an appropriate diagnosis is available. All exclusions and cases with missing or inappropriate diagnoses (eg liver transplant) are shown schematically in the decision tree on page 54.

APACHE II produces an expected mortality rate for a unit, which can be compared to the actual observed mortality rate to give a standardised mortality ratio (SMR). An SMR significantly greater than 1 suggests that mortality is higher than expected, and a value of less than 1 that it is lower than expected. It is important to interpret SMRs with caution. It should be appreciated that whilst the APACHE II scoring system adjusts for case-mix, it does not do so perfectly. This scoring system is now nearly 30 years old. Many units admit a relatively small number of patients each year and the confidence intervals around the SMR are therefore wide. Exact confidence intervals for SMR are calculated by the method described by Ulm(1990)\(^14\)
Figure A4: Eligibility for APACHE II scores and selection for analysis

ALL unit admissions
35,107

HDU
25,305

ICU/HDU
3,745

ICU
6,057

Despite APACHE II scores being calculated for 519 (2.1%) HDU unit admissions, these are excluded from SICSAG analysis.

Exclusions

Episodes Included in SMR Calculation
3221 (86.0%)

Episodes Included in SMR Calculation
5034 (83.1%)

Episodes with Missing Ultimate Hospital Outcomes, Excluded from SMR Calculations

Reason Episode Excluded due to:
Type of admission: missing information
4.4  Level of Care

Levels of care are calculated on a daily basis from the Augmented Care Period (ACP) section of WardWatcher. The ACP page was updated in 2008/2009 and the method of calculating level of care was then updated to ensure compatibility with the rest of the UK.

4.4.1  WardWatcher (2008 version)

The updated version will score levels of care based on support of five different organ systems: respiratory, cardiovascular, renal, neurological and dermatological.

Level 3
- Advanced respiratory support (connected to a ventilator via ETT or tracheostomy) OR
- Two or more organ systems are being supported (except basic respiratory and basic cardiac) OR
- One organ system is being supported and a different system is in chronic failure *

Level 2
- One organ supported

Level 1
- Epidural or/and
- General observations requiring more monitoring than can be provided on a general ward

Level 0
- A patient is assessed as level 0 if not assessed as level 1, 2 or 3 (e.g. no organ support and adequate monitoring could be provided on a general ward)

4.4.2  Older versions

The old version of WardWatcher scored level of care based on the support of four different organ systems: respiratory, cardiovascular, renal and neurological.

Level 3
- As in new version

Level 2
- One organ system supported OR
- No organ is being supported but either there is a requirement for more observation or monitoring than could be provided safely on a general ward or there is a potential for deterioration

Level 1
- A patient is assessed as level 1 if not assessed as level 2 or 3

* Chronic failure is collected from the PMH section of the history page in WardWatcher.
4.5 Delayed Discharges

Delayed discharge data is collected on the unit discharge page of WardWatcher (WW). The first question asks whether the patient is **ready for discharge** (defined as a medical decision to discharge a patient to another, more appropriate unit). This may be a lower level of care or a specialist area. **No** is entered if the patient is discharged early or self discharges against medical advise. A date and time is then entered when this decision is made and then a date and time is entered when the patient physically leaves the unit. The ‘gap’ between these two times is calculated and the final question asks users to consider this gap as normal or abnormal.

Normal delay would be the time taken by unit staff to get the patient ready for discharge and assemble relevant documents required for discharge.

Abnormal delay has seven sub categories: Ward bed shortage, HDU bed shortage, ICU bed shortage, nursing staff shortage, other staff shortage, transport problem or other.

The upgraded version of WW now enforces staff to enter a time delay and objectively say why a delay has occurred. SICSAG have not defined any specific time delay as acceptable as each hospital will differ in practice, however this year we have included analysis on delayed discharges that are considered abnormal and the gap is more than six hours.

This information can be reported locally and is also part of the monthly report data.
# Appendix 5  List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tr>
<td>ACCS</td>
<td>Acute Care Common Stem</td>
</tr>
<tr>
<td>ACP</td>
<td>Augmented Care Period</td>
</tr>
<tr>
<td>CCU</td>
<td>Coronary Care Unit</td>
</tr>
<tr>
<td>CDAD</td>
<td>Clostridium Difficile Associated Disease</td>
</tr>
<tr>
<td>CDiff</td>
<td>Clostridium Difficile</td>
</tr>
<tr>
<td>CPAP</td>
<td>Continuous Positive Airway Pressure</td>
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<tr>
<td>CVC</td>
<td>Central Venous Catheter</td>
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<td>DVT</td>
<td>Deep Vein Thrombosis</td>
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<td>Foundation Year (medical)</td>
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<td>GCS</td>
<td>Glasgow Coma Scale</td>
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<td>Healthcare Associated Infection</td>
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<td>Hospital at Night</td>
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<td>HDU</td>
<td>High Dependency Unit</td>
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<td>HELICS</td>
<td>Hospitals in Europe Link for Infection Control through Surveillance</td>
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Acknowledgements

This report was written by the Report Writing Subgroup of the SICSAG Steering Group.

Report Writing Subgroup 2010/2011

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