Scottish Intensive Care Society Audit Group

ANNUAL REPORT 1999

An Audit of Intensive Care Units in Scotland.

Clinical Effectiveness Programme 99/50

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A) INTRODUCTION

1. This report is the result of an ongoing financial commitment by the Department of Health to support the evaluation of the quality of intensive care and the adequacy of bed provision in Scotland. The provision of central funding, rather than requiring successful negotiation with individual Trusts, as in England, has led to data being available for almost every intensive care unit in the country. It follows that we are able to provide a comprehensive national review. The successful implementation of the audit has required a commitment by both medical and nursing staff to take on data collection as a part of their routine work, thus avoiding the cost of dedicated data collectors.

2. Collation of completed hospital outcome demands that data in this report predominantly reflect performance to the end of 1998 although we are aware that it appears at a time when ICU facilities in Scotland, and the rest of the UK, are experiencing exceptional demand. Consequently, we depart from normal practice by including workload data for the first half of 1999 and provide information on the increase in ICU bed provision to January 2000.

3. We believe, as stated in previous reports, that annual workload data is the appropriate source of information from which to inform discussions between ICUs and their respective Health Boards on the appropriate level of ICU bed provision. The Society does not seek to exploit the current exceptional pressure on ICU bed provision to make excessive demands on limited health care resources. We believe these issues are best dealt with by medium-term planning and subjected to regular review. This is an ongoing process. To date we have collaborated in reviews of ICU bed provision in Greater Glasgow Health Board (GGHB) and Argyll and Clyde Health Board (A&CHB). Audit data have also been used to inform an assessment of ICU need in Aberdeen Royal Infirmary. We continue to believe that this systematic, collaborative approach is the way forward. Nevertheless, the current episode should cause us to debate the extent to which critical care provision should take account of the need to meet peaks of demand and how this might be achieved. The following proposals should form the basis for constructive discussion with medical and nursing staff, Health Boards and central Government.

3.1. ICU Bed Provision and Staffing.

The number of staffed ICU beds needs to be reviewed periodically in the light of changes in both 'normal' and 'peak' activity. To date we have worked on the assumption that an occupancy rate of 70% of the staffed beds probably indicates adequate provision. This has resulted in a significant expansion of bed provision in a number of Trusts. This 70% figure is somewhat arbitrary and may have to be reviewed, particularly in Trusts where alternative mechanisms of providing flexibility are limited.

3.2. Coping with Exceptional Demands.

Trusts should identify where and to what extent additional bed spaces can be recruited during periods of exceptional demand. The appropriate arrangements will vary according to local circumstances, such as the availability of either specialist intensive care beds, (e.g. cardiac

surgery) or intermediate care beds in medical/surgical high dependency units (HDUs). Recruitment of additional resources from HDUs would inevitably be limited by availability of nursing staff with appropriate levels of expertise, and critical care equipment such as ventilators and invasive monitoring. While the latter provision has implications for additional capital expenditure, provision of a larger pool of critical care nurses represents a greater challenge. One alternative would be to incorporate nurses in intermediate care facilities and ICU into one pool. We propose that the Scottish Intensive Care Society should set up a multidisciplinary group to provide guidance on this issue, accepting that the optimum mechanism of providing such flexibility will be institution-specific.

3.3. High Dependency Beds.

The identification of high dependency beds as a possible mechanism of providing flexibility in some Trusts emphasises the need to systematically evaluate the adequacy of HDU provision and to seek to address deficiencies. Even at a time of exceptional demand for ICU beds, inadequate HDU provision is consistently raised as an important issue by ICU consultants. In some hospitals inadequate HDU provision may be a greater concern than lack of ICU beds, however, inadequate ICU provision is clearly the major consideration in others.

3.4. Bed Bureau.

Our last Annual Report[1] indicated our intention to set up an electronic Bed Bureau within Glasgow and thereafter to extend this nationally. Our expectation that the system would be functional in Glasgow for this winter has been stalled by delays in comprehensively linking the Glasgow hospitals to the NHSnet. Recent discussions indicate that, by the time of publication of this report, it will be established in Glasgow. In response to demand, provoked by current difficulties, we intend to establish this nationally as a matter of urgency. We anticipate that, as in Glasgow, the rate-limiting step will be the connection of each ICU to the NHSnet. Transfer of critically ill patients is not a pattern of care that we seek to promote, nonetheless, when required, it occurs at times when there are exceptional pressures on staff. The time spent identifying an available bed detracts from patient care and increases the time during which the patient may have to be cared for in a temporary ICU 'facility'. The Bed Bureau should render this process far more efficient and further facilitate collaboration across the Scottish critical care network. Provision of this service represents another benefit of our comprehensive audit system.

3.5. Physical Capacity.

A significant factor limiting expansion of ICU bed provision in a number of hospitals is that current ICU provision is utilising all available space. In such cases, increasing provision requires significant capital expenditure. All current trends indicate that intensive care provision will require to be progressively increased for the foreseeable future. Two members (JC Howie & IS Grant) have been involved in advising on the revision of the ICU building note (HBN27) for use in Scotland. It is quite clear that this should incorporate the space to expand to meet these trends. In any new development consideration should be given to the juxtaposition of HDU beds in order to provide flexibility in level of care.

3.6. Service Re-design.

It appears likely that the trend in Scotland will be to deliver acute services from a smaller number of sites. This will have the effect of encouraging the development of larger intensive care units. Larger units are likely to be able to accommodate fluctuations in demand more readily and will be full on fewer occasions. Acute service re-design should seek to place all patients who may require intensive care on a single hospital site because if one ICU has to support several different hospitals then inter-hospital transfers will increase. Such transfers should be kept to a minimum. Centralisation of acute services leads to a reduction in trainee rotas. Consequently larger units may be more efficient in their use of staff. It should be appreciated that a critical increase in size may require a step increase in medical staffing at both consultant and trainee level.

3.7. Medical Staffing.

Both at a consultant and trainee level, intensive care in Scotland is provided predominantly by anaesthetists. An expanding requirement for ICU beds occurs at a time when we anticipate that the number of anaesthetic trainees may require to be reduced in order to match them more appropriately to expected consultant vacancies. This has implications both for service provision and for providing balance in training.

4. Our last report[(1)] included a review of outcomes in patients requiring both respiratory and renal support. With a trend towards providing renal support across a wider range of ICUs, it was reassuring to find limited variation in outcome and no volume effect. This outcome evaluation has now been followed by questionnaire-based assessments of process of care in renal support. Summaries of this work are appended (Appendices I & II).

5. We are currently completing an evaluation of outcome from the Adult Respiratory Distress Syndrome. Interim results from this study are appended (Appendix III). This represents the first group of patients who will have detailed follow up of quality of life assessed by questionnaire, combined with assessment of pulmonary function.

6. While the primary objective of the audit is to provide quality assurance and assess appropriate service provision, the established structure provides the opportunity to undertake multi-centre research studies of the effectiveness of specific ICU processes of care. A clinical trials group functioning independently of the audit structure has now been set up to take forward this agenda.

7. In terms of data collection we have now established collection of a core set of ICU interventions (ACP data) to replace or compliment TISS data. This should allow an ICU to make more detailed assessment of their ICU workload. The revised diagnostic list should make the information available at a local level more clinically meaningful, however it is scheduled for revision to correct recognised anomalies.

8. We have been approached by a number of hospitals requesting permission to use the database on their HDU. We intend to assess the level of demand for this, with the possibility that we could adapt the database specifically for HDU use.

9. Integration of ICU data into national health care statistics, as a matter of routine, remains an important objective. To this end, discussions with the Information & Statistics Division (ISD) on an agreed dataset linked to SMR1 returns is ongoing.

10. Once again individual intensive care units are identified for all data, with the exception of standardised mortality ratios (SMRs). Although SMR data are not contentious, given the narrow range, compared to results recently published by the Audit Commission for England and Wales, it remains our view that no gain will accrue from publishing these data on a named hospital basis.

11. The Society has recently launched a web-site (www.scottishintensivecare.org.uk) which it is hoped will become a focus not only for medical and paramedical groups involved in intensive care, but a source of information and feedback for patients and their relatives who have experienced the stress of critical illness. A copy of this report will be available on the site from which it can be downloaded. We would encourage those wishing to comment, particularly on the proposals for increasing flexibility to do so via the web-site, either by email to the audit office or within the discussion forum.

B) RESULTS

12. Data presented in this Report, although drawn predominantly from a static group of intensive care units, has significant variations year on year due to small ICUs joining the study in recent years. Additions since the last Report are: Ayr Hospital and Dumfries Royal Infirmary, both with data included since February 1998. Hairmyres Hospital has been participating since October 1999 and will be included in the future Reports. Falkirk Royal Infirmary ceased providing complete data in March 98 although it has provided occupancy data for the remainder of that year. This information is particularly relevant to interpretation of aggregated Health Board data. A list of participating ICUs is available in Appendix IV. This table enables identification of the individual units in the workload & occupancy graphs. Individual units should contact Fiona to ascertain their letter for the SMR graphs.

13. Consistency in the characteristics of admissions during 1998 with those of the previous 3 years can be seen in Table 1.

Table 1. Summary characteristics of admissions between 01/01/95-31/12/97 and 1998

	All patients		Patients with APACHE II prediction	
	1995-1997	1998	1995-1997	1998
N	20,738	8,327	15,437	6,100
Operative (%)	49	48	-	-
Non-operative (%)	51	52	-	-
Male (%)	55	56	-	-
Female (%)	45	44	-	-
Age (y) (range)	58.2 (0 - 99)	60.1 (0-99)	59.1 (16 -99)	59.4 (16 -100)
Mean length of ICU stay (d)	4.3	4.36	4.92	4.76
Median length of ICU stay (d)	1.83	1.8	2.02	2
Range of ICU stay (d)	0 - 142	0-84	-	-
ICU mortality (%)	19.0	19.2	19.3	19.4
Hospital mortality (%)	26.7	27.2	28.5	29.7
APACHE II score	-	-	18.3	18.8
APACHE II prediction (%)	-	-	30	31.7
SMR (95% CIs)	-	-	0.95 (0.93 - 0.97)	0.87 (0.84 - 0.91)

B.1. ICU Demand

14. Quoting from our last Annual Report[1], "Concern continues to be expressed around the episodic requirement for ICU beds.... Occupancy is found to be most consistently high in the period December - March at which time it is in excess of 80%. In 1997 the mean occupancy was consistently 85% in these months, indicating that in units with the greatest overall demand, demand will be excessive". This trend is once again evident in the data for 1998, however the fluctuation in bed occupancy throughout the year is less pronounced (Figure 1).

15. Figure 2 shows that the progressive increase in overall bed occupancy seen over the previous three years was not maintained in 1998. This is, in part, explained by the recruitment of two ICUs, with ICU/HDU flexibility and therefore, with relatively low occupancy and by increased bed provision on a number of sites.

16. Inclusion of data for 1999 (Figure 3) allows a more up to date examination of the trend in occupancy over the months of peak demand (January - March) over a 5-year period. As for overall occupancy, the high levels of occupancy have been sustained for the period 1997-1999, but without any further consistent increase. Clearly the data for 2000 is going to show a very sharp increase in demand.

17. Figure 4 demonstrates the year-on-year pattern of occupancy for each ICU with considerable variation in occupancy across the ICUs being evident. Bed occupancy is based on our understanding of the number of funded beds. This is particularly difficult in HDU/ICUs where units may have flexible use of beds, accommodating a large number of HDU patients or a small number of ICU patients. In general we believe this leads to an underestimate of occupancy, therefore, these units have been asterisked.

18. Figures 5 and 6 use the proportion of days ventilated (obtained from the daily intervention data collected on the 'ACP' screen) as an indication of the extent to which pressure on beds could be alleviated by additional HDU rather than ICU beds. Figure 5 shows the proportion of occupied bed days in each hospital in which patients are ventilated and Figure 6 shows the proportion of available bed days in which patients are ventilated. Days ventilated is taken as a marker rather than an absolute indication of ICU bed requirement, as patients may require to be in ICU even though not ventilated. This type of data should be combined with information on severity of illness at admission to provide a more complete picture of resource utilisation.

19. Figure 7 shows the variation and trend in length of stay across Scottish ICUs. As explained in detail in last year's annual report (available on the web-site), whilst the relationship between severity of illness and length of ICU stay is non-linear, for the majority of patients length of stay increases with increasing severity of illness. Thus Table 2 compares length of stay for each unit with the mean for the previous 3 years along with the respective mortality probabilities. Attempts to provide a model of length of stay prediction, to improve benchmarking of this important outcome, are ongoing.

Table 2. Mean mortality probability and length of ICU stay.

Unit	APACHE Probability (%) 1995-97	Length of Stay (d) 1995-97	APACHE Probability (%) 1998	Length of Stay (d) 1998
A	33.7	4.6	38.8	3.5
B	-	-	38.6	3.7
C	31.4	3.4	30.8	3.8
D	23.1	3.8	25.0	3.1
E	24.0	3.8	21.6	3.9
F	36.0	5.1	36.1	6.3
G	30.6	4.8	32.8	4.0
H	44.5	8.5	-	-
I	27.7	4.2	25.2	3.5
J	32.2	4.7	35.5	3.8
K	31.1	4.2	32.3	4.6
L	19.5	4.2	25.2	4.4
M	24.4	3.7	32.3	5.6
N	32.1	4.6	32.4	4.2
O	28.5	4.8	29.0	4.9
P	-	-	23.7	4.9
Q	36.6	4.9	37.0	5.1
R	29.6	4.8	35.6	6.2
S	29.4	5.3	28.3	5.3
T	34.3	5.1	39.4	5.1
U	30.1	5.4	30.0	5.0
V	26.4	5.5	32.2	4.8
W	33.2	5.0	35.6	5.8
X	29.3	7.0	30.6	7.8
Y	31.6	6.8	33.6	7.1

B.2. Health Board Analysis

20. It is quite clear from these data that a number of ICUs are under considerable pressure on beds. We have, therefore, analysed these data by Health Board, as they are the funding agencies. Table 3 shows the trend in occupancy and ICU provision while Figures 8 and 9 present data from Figures 5 and 6, aggregated by Health Board. It should again be emphasised that data from Boards such as Argyll & Clyde, which have a flexible use of beds in predominantly HDU/ICU facilities, underestimates ICU occupancy. This Health Board has, within the last 12-months, undertaken a thorough examination of its ICU and HDU requirements, using our benchmarked audit data as an important source. The extent to which these recommendations will be implemented is, at the time of writing, uncertain. A fairly arbitrary figure of 10 ICU beds (RAH 3, Inverclyde 3, Vale of Leven 4) has been used in the calculation of occupancies. Within that Board, the number of fully funded, recognised ICU beds during 1998 was 2 (RAH 2, Inverclyde 0, Vale of Leven 0). We understand the current proposal is to increase this to 4, 3 and 2 respectively, with additional HDU beds. January 2000 saw the implementation of ICU expansion in GGHB (25 to 29), recommended as part of a similar review of ICU bed requirement. At present we anticipate providing Lothian Health Board with similar data in the early part of this year, and we understand that systematic evaluation of ICU bed requirement in conjunction with HDU needs assessment is also ongoing in Ayrshire and Arran.

21. It should be remembered that comparison of bed provision in relation to population (beds/100,000) cannot take account of cross-boundary flow which, for some Boards, may be considerable. The data for January 2000 identifies expected number of funded beds within this current year.

22. Table 4 provides 2 snapshot pictures of the obvious pressure on ICU beds early in January 2000. Figure 3 displays occupancy data for January in the 3 preceding years. It is clear that the pressure experienced recently has not been experienced to the same extent previously.

23. While ICUs have developed to meet the needs of postoperative patients it is quite clear that, in terms of patient numbers and particularly in terms of occupied bed days, postoperative patients no longer dominate, especially in the city hospitals. Figure 10 shows the pattern of patient admissions according to source for the period 1995-98. This demonstrates a considerable variation in the proportion of patients admitted from theatre. Figures 11 and 12 divide this up into city hospital Health Boards and district general hospital Health Boards respectively. Figures 13-24 allow examination of the source of patients for each Health Board and the contribution to occupied bed days. The relatively low contribution of postoperative patients to occupied bed days is particularly striking in Lothian, Grampian and GGHB. The significance of much of these data requires local interpretation. Data from Borders is strikingly different due to the practice of pre-optimisation of high-risk surgical patients who are coded as coming from a ward rather than theatre. The significant contribution of patients from other hospitals and from other ICUs in the GGHB data represents a combination of tertiary referral and tendency of GGHB ICUs to function as a small network. This set-up provides a means of coping with peak periods of demand in individual hospitals. Figures 25-36 allow examination of trends in occupied bed days associated with each admission source for each Health Board over a 4-year period.

Table 3. ICU bed numbers and occupancy by Health Board. Data from 1998. * Lanarkshire: Hairmyres - no occupancy data.

Health Board	Population (n)	ICU beds (n)	HDU beds in ICU (n)	ICU Beds per 100,000	Occupancy (%)	Expected ICU beds in 2000 (n)
Grampian	528,400	8		1.51	98.7	9
Argyll & Clyde	429,300	8	3	1.86	70	9
Lanarkshire*	561,600	12		2.14	73.8	12
Ayrshire & Arran	376,500	9		2.39	68.2	9
Highland	208,600	5		2.40	78.7	5
Tayside	392,400	10		2.55	74.6	10
Dumfries	147,300	4	2	2.72	89.7	4
Lothian Health	772,000	21		2.72	81.4	22.5
Fife	348,400	9.5		2.73	78.7	10
GGHB	905,100	25		2.76	86	29
Borders	106,200	3		2.82	83.7	3
Forth Valley	275,600	9	4	3.27	61	8
Total for Scotland	5,122,500	123.5		2.41	78.7	130.5

Table 4. Snapshot of pressure on ICU beds: January 2000.

HEALTH BOARD	HOSPITAL	FUNDED BEDS (n)	OCCUPIED BEDS (n) 06/01/2000	OCCUPIED BEDS (n) 12/01/2000
Ayrshire & Arran	Ayr Hospital	4	5	6
	Crosshouse Hospital	5	5	8
Argyll & Clyde	Inverclyde Royal Hospital	3	3	4
	Vale of Leven	2	3	3
	Royal Alexandra Hospital	3	4	3
Borders	Borders General Hospital	3	4	4
Dumfries & Galloway	Dumfries Royal Infirmary	4	4	3
Forth Valley	Stirling Royal Infirmary	3	4	4
	Falkirk Royal Infirmary	5	5	5
Fife	Victoria Hospital	4	4	4
	Queen Margaret Hospital	6	6	6
Grampian	Aberdeen Royal	9	9	16
GGHB	Western Infirmary	7	7	8
	Glasgow Royal Infirmary	7	7	8
	Victoria Infirmary	5	5	5
	Stobhill Hospital	5	6	6
	SITU, Southern General	5	5	5
Highland	Raigmore Hospital	5	10	7
Lanarkshire	Hairmyres Hospital	3	2	5
	Law Hospital	4	5	5
	Monklands Hospital	5	5	6
Lothian	Royal Infirmary of Edinburgh	10.5	15	13
	Western General Hospital	8	9	11
	St. John's Hospital	4	4	6
Tayside	Ninewells Hospital	7	6	7
	Perth Royal Infirmary	3	4	4
		129.5	146	162

B.3. Demography

24. An important driver of increasing bed demand is that we provide health care to an increasingly elderly population, at a time when society's expectations of what can be achieved for elderly patients, even in a critical care setting, are quite properly increasing. Figure 37 demonstrates the remarkably consistent age distribution of the ICU population, with the greatest absolute increase occurring in the 66-70 age group. As expected there is a consistent increase in mortality with age, uncorrected for severity of illness (Figure 38). A striking difference in pattern of mortality in elderly patients is the much higher mortality occurring following ICU discharge. Nevertheless, there is no indication in these data that admission of elderly patients to ICU is inappropriate.

B.4. Case Mix Adjusted Outcome

25. Their has been a concern that our inability to routinely link ultimate hospital outcomes for patients transferred to a second intensive care unit, while making little impact on national SMRs, might distort apparent performance in units who routinely transfer a relatively larger proportion of patients for tertiary referral. Linkage to ISD data has allowed evaluation of this aspect by providing complete hospital outcomes for the majority of patients up to March 1998. As expected, this has made little impact on the pattern of SMRs. Thus Figure 39 displays the distribution of SMRs for admissions during 1996-1998. For reasons previously explained (1998 Annual Report,[1] available on the web-site) data are divided into operative and non-operative admissions (Figures 40 & 41).

26. Overall there has been a progressive reduction in the Scottish SMR over the last 3 years, whether we examine all available data (Figure 42) or subdivide it by admission source (Figure 43) or restrict it (Figure 44) to only those units who have complete data sets for that period (a small number of units were recruited late).

27. From the outset of the audit there has been interest expressed in the relative performance of teaching hospitals and district general hospitals (DGHs). Figure 45 compares the SMRs for these two hospital groups divided by source. We invite comment on the apparent disparity in performance of DGH and teaching hospitals for non-operative and post-operative patients (Figures 40, 41 & 45).

28. The Audit Commission report highlighted a considerable variation in APACHE II SMRs in England and Wales. Differences in the organisation of consultant rotas were associated with a different pattern of SMRs[2]. Lower SMRs were found in units where consultants worked on the unit for one-week blocks. Whether this was due to improved continuity of care or, as suggested in one newspaper interview, that it was a marker for a more committed consultant workforce, is not clear. SMRs in Scotland overall, are comparable to those reported for the subset of better performing ICUs in England and Wales. Figure 46 shows a comparison of comprehensive Scottish SMRs based on mortality tracked to final hospital discharge and those units in England and Wales contributing data to the Audit Commission report.

29. There are well-recognised difficulties in using clinical outcomes to drive an audit cycle where the evidence base identifying best practice is limited. This is clearly the case in intensive care. In our last Annual Report (1998)[1] we identified a unit which, in the first year, had a significantly high SMR that improved over subsequent years (Unit T in 1998 & Unit M in 1999). We have discussed with the consultants in that unit, the extent to which this may have resulted from significant change in practice. They identified trends towards the decreased use of pulmonary artery catheters (their use is not high by national standards), decreased use of heavy sedation and muscle relaxants, the use of prone ventilation and pressure-regulated ventilation and increased use of enteral nutrition.

B.5. Death Following ICU Discharge

30. It is important to remember that of all Scottish ICU admissions, the ICU survival rate is 81% (Figure 47). Approximately one third of all deaths of ICU patients occur in the ward following ICU discharge. Early in our audit we recognised a disconcerting time course, with mortality rate peaking in the first 48-hours after ICU discharge (Figure 48). This prompted retrospective audit of such deaths in two hospitals. The results indicated that the vast majority of deaths could have been anticipated and did not appear to result from inadequate care. To test this prospectively, the minimum dataset has required the doctor discharging the patient to indicate whether the patient was expected to live or not and whether readmission would be appropriate in the event of a subsequent deterioration. By allowing three possible responses to the above questions, patients can be placed in one of nine categories. Table 5 shows the proportions in each and Table 6, the percentage mortality. Surprisingly we have found responses to these questions to be complimentary in discriminating survivors and non-survivors. Analysis of the data in relation to time of death following ICU discharge (Figure 49), confirms that early deaths occur predominantly in patients in whom death was anticipated and readmission was deemed inappropriate. Local audit of quality of care following discharge, or appropriateness of discharge, particularly where it has been provoked by pressure on beds, should concentrate on deaths occurring early after discharge, in patients who were anticipated survivors and for whom readmission would have been deemed appropriate.

Table 5. Proportion of ICU survivors within each prediction of outcome.

		Do you expect patient to survive?		
		Yes	Uncertain	No
Would you readmit?	Yes	3728 (76.8%)	287 (6.1%)	19 (0.4%)
	Uncertain	156 (3.2%)	269 (5.5%)	19 (0.4%)
	No	54 (1.1%)	163 (3.4%)	147 (3.0%)

Table 6. Hospital mortality within each prediction of outcome.

		Do you expect patient to survive?		
		Yes	Uncertain	No
Would you readmit?	Yes	5.1%	13.5%	15.8%
	Uncertain	10.9%	22.7%	52.6%
	No	14.8%	31.2%	71.4%

C) CONCLUSIONS

31. The results of this ongoing audit of intensive care continue to present a healthy picture of the specialty in Scotland. A network is evolving which will provide standard setting, both in terms of appropriateness of service provision and quality assurance. Collaboration, which has been so crucial over the current period of exceptional demand, has been underpinned by the knowledge that comparable outcomes are achieved across the country. This collaboration will be further supported by a national Bed Bureau. We anticipate that ongoing progress will be made towards optimising the matching of supply and demand for staffed ICU beds. The requirement to examine mechanisms of improving flexibility of ICU bed provision at both a local and national level is a priority over the next 12 months.

D) ACKNOWLEDGEMENTS.

32. This comprehensive audit would not be possible without the ongoing provision of national funding from CRAG, the willingness of medical and nursing staff to take on the demands of yet more data collection without additional assistance, and the energy of the audit office staff. The web site has been set up by Mr Stephen Kettlewell and funded for one year by Bayer Pharmaceuticals. The English & Welsh SMRs were provided by the Intensive Care National Audit and Research Centre (ICNARC).

E) REFERENCES

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APPENDIX I

A SURVEY OF THE STRUCTURE AND PROCESS OF RENAL REPLACEMENT THERAPY IN SCOTTISH INTENSIVE CARE UNITS.

J S Noble, J Ross, F N MacKirdy, J C Howie, S J Mackenzie.

INTRODUCTION: An increasing number of Scottish intensive care units (ICU) are providing renal replacement therapy (RRT). We examined the structure and process of this developing service.

METHODS: The study took the form of an interview carried out by a research nurse using a structured questionnaire. The interviewee was if possible, the consultant who had most involvement with renal support in that unit. In addition, the amount of RRT activity that took place between July 1998 and June 1999 was determined from the SICSAG database.

RESULTS: Nineteen Scottish units provided RRT at the time of the survey and of these 7 were teaching hospitals. There were 7542 admissions to these ICUs for this time period. The mean age was 58.2 years, the mean ICU length of stay was 4.35 days and the mean APACHE II score was 19. In 390 (5.17%) of these admissions, RRT was administered. The median admission was 327.5(mol/l. The patients received a mean 6.6 days of RRT. Mechanical ventilation was required in 85.8% of cases and 79% received inotropic support. RRT was first administered most commonly on day 2. The mean length of ICU admission for RRT patients was 12.6 days.

Only three of these units ran the RRT by protocol, six used standard practice and ten had no standard practice. Four units audited complications of RRT. Six interviewees recalled 1-3 incidents of major haemorrhage on RRT during the previous three years. RRT is prescribed by the renal physician and intensivist on nine units, by the intensivist alone on nine units and by the renal physician alone on one unit. Following optimum fluid loading if oligo-anuria persists, 8 units employ dopamine, 14 employ frusemide, 4 employ mannitol and one uses combined infusions of aminophylline and frusemide. The reasons given were ease of fluid management, reversal of renal failure, renal protection and conversion to renal failure with an output.

In four units intermittent haemodialysis (IHD) is the main RRT technique employed on ICU (estimated 60,70,80,100% of workload respectively). Other than one unit that employs continuous haemodiafiltration in an estimated 60% of cases, continuous (CVVH) or intermittent haemofiltration (IVVH) provides the majority of RRT in the remainder. The specific reasons given for the predominance of technique were mainly logistical and to a lesser extent clinical. The trend in RRT has been towards increased or stable levels of IVVH, CVVH and IHD. However two units estimated that they were using less IHD.

There is no consistent central venous access site favoured across the Scottish units. Nutritional therapy is largely unaffected by the onset of ARF and the need for RRT. Heparin is still the most frequently prescribed anticoagulant for RRT because it is perceived as cheap

and effective. If thrombocytopenia supervenes, epoprostenol is employed in 7 units and low molecular weight heparin in 2.

CONCLUSIONS: In Scottish units the predominant RRT treatment modalities vary widely. In the absence of formal protocols there is a diversity of clinical practice.
Financial support from GlaxoWellcome

APPENDIX II

A SURVEY OF THE NURSING ROLE IN RENAL REPLACEMENT THERAPY IN SCOTTISH INTENSIVE CARE UNITS.

Jane Ross, Research and Audit Sister

Scottish Intensive Care Society Audit Group

INTRODUCTION: In the past decade intensive care nurses have expanded their role to incorporate renal replacement therapy (RRT) as an accepted part of critical care. This survey was designed to examine how that changing role has developed, where we are now and what the future holds.

METHODS: Nineteen Scottish intensive care units (ICUs) were identified as involved in RRT. Of these, seven were supported in varying degrees by the on-site renal unit. A questionnaire was conducted by structured interview with a nurse from each of the ICU and renal units. The questionnaire was divided into 5 specific areas of education and organisation, equipment, the therapy, patient care and the future.

RESULTS: The results demonstrate that RRT has been incorporated into the ICU nurse's role in 84% (16 units) of the areas that provide the therapy. In the remaining 16% (3 units) RRT is provided uniquely by the on-site renal nursing staff. This service provision is additional workload for the renal units concerned. It has also been identified as potentially dissatisfying for the renal staff involved since they have limited clinical involvement in the patient care. These 3 units are in transitional stages of establishing their own ICU RRT service. A further 4 renal units offer varying levels of support. This ranges from the provision of haemodialysis rather than haemofiltration, to guidance with education or training. Twelve units are completely autonomous in their RRT service. Education and training are seen as essential in the establishment of renal therapy and are predominantly clinically service led (85%). Only 15% are provided by external or commercial sources. Equipment and Renal techniques varied between sites. Patient care is generally delivered using research-based knowledge. It was obvious from the nursing staff interviewed that there is continual search to update and develop this knowledge. The future is one of continual collaboration between intensive care and renal areas to meet the challenge of a complex changing service. There was a need identified for an accredited training course in RRT for ICU staff. One area being explored is that of developing care workers to have a greater involvement in RRT provision.

CONCLUSION: Scottish intensive care nurses have grasped the challenge to incorporate RRT in their critical care role and are keen to continue development into the millennium.

Thanks to the ICU and Renal staff who took time to assist me with the completion of this survey. Financial Support from GlaxoWellcome

APPENDIX III

A PROSPECTIVE, OBSERVATIONAL STUDY OF ARDS IN A COHORT OF PATIENTS IN SCOTTISH INTENSIVE CARE UNITS

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INTRODUCTION: ARDS continues to be associated with a high mortality. The SICS is currently assessing the incidence of ARDS in its adult ICU population, the underlying condition, treatment regimens and the outcome, in terms of mortality, pulmonary function and quality of life.

METHODS: Prospective daily data collection occurs in 21 ICUs using Ward Watcher software (Critical Care Audit Ltd). Patients are identified as ARDS using the American European Consensus definition. A research nurse collects additional data retrospectively and validates the data recorded by ICU staff.

RESULTS: In this preliminary analysis, ARDS was diagnosed in 154 patients in a 4-month period. The underlying diagnosis was pulmonary in origin in 38.4% and extrapulmonary in 61.6%. Mean age was 54.4 years and mean first 24-hour APACHE II score, 21.9. Females accounted for 53.2% of patients. On the day of diagnosis, mean PaO2/FiO2 was 121.9 mmHg, mean PEEP was 7.8 cmH2O, mean tidal volume was 633 ml and mean peak inspiratory pressure was 30.5 cmH2O. From a total of 6 organ failures, 30.5% had 1, 51.3% had 2, 15.6% had 3, 1.3% had 4 and 1.3% had 5 organ failures on the day of ARDS diagnosis. Mean ICU length of stay was 12.2 days. ICU mortality was higher than expected at 54.5% (pulmonary mortality = 49.2%; extrapulmonary mortality = 57.8%).

CONCLUSIONS: In an unselected, general ICU population, whose overall outcome is comparable with published series (APACHE II SMR=0.95), the mortality from ARDS remains high in comparison to individual series demonstrating recent improvement in ARDS outcome. Further study into the process of intensive care is required to explain the apparently selective poor mortality from ARDS.

Funding: Clinical Resource and Audit Group, Scottish Office; AstraZeneca.

APPENDIX IV

KEY TO UNITS IN WORKLOAD GRAPHS. TABLE OF PARTICIPATING ICUs.

Unit ID	Intensive Care Unit	Lead Audit Consultant	Participation in Audit
A	Royal Alexandra Hospital, Paisley	Dr S Madsen	1995
B	The Ayr Hospital	Dr I Taylor	1998
C	Borders General Hospital, Melrose	Dr NP Leary	1995
D	Queen Margaret Hospital, Dunfermline	Dr P Curry	1995
E	Inverclyde Royal Hospital, Greenock	Dr F Munro	1995
F	Vale of Leven DGH, Alexandria	Dr WR Easy	1995
G	Crosshouse Hospital	Dr R White	1995
H	Falkirk Royal Infirmary	Dr D Simpson	only occupancy data since 1998
I	Victoria Hospital, Kirkcaldy	Dr C Wilson	1995
J	Monklands Hospital, Airdrie	Dr D Clough	1995
K	Victoria Infirmary, Glasgow	Dr A Dell	1995
L	Perth Royal Infirmary	Dr FD Magahy	1995
M	Stirling Royal Infirmary	Dr M Worsley	1995
N	Western Infirmary, Glasgow	Dr L Plenderleith	1995
O	St. John's Hospital, Livingston	Dr M Fried	1995
P	Dumfries & Galloway Royal Infirmary	Dr D Williams	1998
Q	Stobhill Hospital	Dr C Miller	1995
R	Surgical ICU, Southern General Hospital	Dr J MacDonald	1995
S	Law Hospital, Carluke	Dr N Willis	1995
T	Glasgow Royal Infirmary	Dr J Kinsella	1997
U	Aberdeen Royal Infirmary	Dr G Adey	1995
V	Raigmore Hospital, Inverness	Dr I Skipsey	1995
W	Royal Infirmary of Edinburgh	Dr SJ Mackenzie	1995
X	Western General Hospital, Edinburgh	Dr IS Grant	1995
Y	Ninewells Hospital, Dundee	Dr AJ Shearer	1995
-	Hairmyres Hospital, East Kilbride	Dr B Cook	Commenced October 1999