Editorials

Resident consultants in large intensive care units – the way of the future?

The paper by Frost and Wise in this edition of the Journal on this subject is timely.[1] As many intensive care units (ICUs) in Australia and New Zealand (NZ) are increasing in size, this issue has exercised individual units and those writing Joint Faculty of Intensive Care Medicine (JFICM) regulations for specialist training. Some ICUs roster their senior registrars on a 12 hour rotating residential roster, but very few have senior staff present on site almost all the time. For many years, some ICUs in Australia and NZ have had the specialist of the day stay on site until the late evening hours before going home and being on call from there.

The issue of resident consultants comes on the background of major changes in the way junior staff are employed. Shifts are becoming shorter and so are total hours worked (in many cases down to an average of between 40 and 50 hours per week) and with these changes there has been a need for more junior staff.

Issues of shorter shifts and working hours for junior staff include:

1. continuity of care and adequacy of transfer of information,[2,3]
2. ability to train specialists to an adequate level in traditional time frames,[4-6] and
3. productivity of junior staff.

The trend to shorter hours is being driven by industrial and safety issues, although the latter is supported by very little scientific evidence when applied to local conditions. It is important to realise that much of the debate on work practices, while relevant to the United States of America, is not all that useful in Australia and NZ. Landrigan *et al*,[3] showed a reduction in error rates in staff during their first and second year postgraduate years working shorter shifts than traditional shifts. However, the current NZ and Australian patterns of rostering are generally shorter than even the "interventional schedule" in their study (i.e. the shorter hours group where errors were reduced). Furthermore, the preventable adverse effects for neither the interns nor the unit-wide staff were statistically different between the traditional schedule (long hours) and the intervention schedule (shorter hours). It is not credible to apply these results obtained from junior medical staff in the United States of America to experienced consultants who move between home and work in NZ and Australia.

However, whatever the science, the shortening junior staff working times alters the consultant work load. Consultants are doing work that would have previously been done by competent juniors. Some junior staff are excellent, but it takes them longer to become so, and there are often more inexperienced staff in the mix. This necessitates increased monitoring, teaching, consultant procedures and involvement in triage and discharge. Consultants are becoming increasingly nervous for the wellbeing of their patients in the face of changed work practices for junior staff and this is one of the legitimate drivers to have consultants or at least senior registrars continually on site.

The JFICM Board recently surveyed Australian and NZ ICUs and most still use the traditional mode of consultant call from home. The amount of time on a total "shift" (home plus call) varies from 24 hours to over 72 hours during weekends. Many work for a whole week with some of the nights off duty, but covering all the days. It is clear that while the rosters may be variable, that consultants are now the staff who offer the main continuity of care for patients and continuity of communication to relatives and other specialists.

The JFICM Board now requires trainees to have 6 months as a senior registrar where they offer continuity of care in a supervised "acting consultant position", for periods longer than a traditional junior staff shift time. The aim is to facilitate the change to a normal consultant experience, and we have had much positive feedback from trainees and new Fellows to this initiative. However, we have also had critical feedback from some very large units, saying that the work is so continually intense and complex, that it makes sense to have senior registrars on 12 - 13 hour shifts at all times.

Two questions arise. Does the fact that senior registrars are never on duty more than 12 - 13 hours prevent them from learning about continuity of care? Furthermore, if a consultant is always on site, do any of the registrars learn to take independent decisions, as they will be required to do on becoming a Fellow?

The Cardiff unit admits 1500 patients into 24 beds. They have 8 full time and 2 half time consultants who work a mixture of 13, 6 and 8 hour days (all start at 0930 hr), and 13 hour nights (i.e. 2130 - 1030 hr). On Saturdays they have two staff doing an 8 hour shift and 24 hour shift (both start at 0930), switching on Sunday. They have leave breaks of about 7 days about every 2 weeks (personal communication). They seem to have overcome some continuity issues by the way they have rostered themselves with most of their shifts occurring in continuous blocks of time, and several consultants starting at the same time. Care in transfer of information, and a team who is working well together,

would be essential to avoid disjointed patient care.

Whether consultants in Australia and NZ would want to go back to what are essentially "registrar rosters" is debateable. Other problems inherent in shift rosters are also present, in that it is difficult with revolving work rosters to take part in outside community interests. Furthermore, hospital committee work, unit meetings with full participation, teaching seminars etc, which occur on a regular schedule, would have to involve commitment in "off duty" hours.

It is likely with the emerging "mega-units" that ICUs will use differing rosters and on call schedules, eventually having at least senior registrars and sometimes consultants rostered on site all the time, while smaller units will continue with present practices. From the point of view of training, both types of ICU may be necessary. In the meantime, the Cardiff experience is reported to be positive from the point of view of the consultants.

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Bringing Stewart to the bedside

In this issue of *Critical Care and Resuscitation*, Drs Lloyd and Freebairn strike another blow for the Stewart approach to acid-base.[1] The article is a follow-up to Dr Lloyd's recent 'Basic Science Review',[2] the subject in both cases being the 'Strong Ion Calculator', devised by Dr Lloyd. This piece of software is built into the Laboratory Information System of the Hawke's Bay Regional Hospital in Hastings, New Zealand and is also available on-line.

In the Basic Science Review Dr Lloyd outlined the theoretical background and internal workings of the Calculator[2] and presented a favourable performance evaluation based on an old data-set from Figge and colleagues.[3] A Monte Carlo type precision analysis was also impressive. In the current article the authors briefly reintroduce the Calculator, then illustrate its application at the bedside, using data from five patients with a range of acid-base disturbances.

The Strong Ion Calculator is first and foremost a practical application of the physical chemical approach. It is based upon Peter Stewart's concepts[4,5] as subsequently refined by Constable.[6] The main differences from the 'standard' physical chemical approach can be summarised under a number of headings.

The acid-base modelling of plasma proteins and phosphate.

At physiological pH, albumin has a negative charge, which varies with pH. Because this property mimics weak acid behaviour, both Stewart and Constable model it as though a weak acid (HA) is variably dissociated to H^+ and A^-. What actually happens is more complex. For a start, almost all the ionised groups on the molecule, both negative and positive, have a fixed degree of dissociation in the physiological pH range. The negative charges predominate, so that the overall charge is always negative. Second, most of the charge variability resides in the imidazole/imidazoline side chains of histidine. These are either uncharged, or when they gain protons, positively charged. As pH falls, further protons are incorporated, reducing the molecular net negative charge.

Constable handles this mathematically by dividing the protein charge into a fixed negative component, which he assigns to the strong ion difference (SID), and a variable negative component representing weak acid behaviour (Atot).[7] The same approach is adopted by Drs Lloyd and Freebairn in their Strong Ion Calculator.[2] In contrast, Stewart incorporates the entire negative charge and its variation into a weak acid model, with no separation into fixed (SID) and variable (A_{tot}) components. The Stewart SID is thus about 4 mEq/L higher than the Constable SID (assuming normal albumin concentrations), because it lacks a protein anionic component.

Obviously neither model replicates the true state of affairs, since most of the variability resides in a moiety which is either uncharged or positively charged, but the approach of Constable and Lloyd may allow more accuracy. Dr Lloyd's Calculator also separates phosph-

ate negative charge into fixed and variable components, again as advocated by Constable.[7]

Assigning weak acid behaviour to globulin as well as albumin.

Figge and colleagues found that plasma protein acid-base behaviour could be modelled quite accurately using albumin alone.[3] In this widely accepted analysis, globulins play a negligible role in acid-base equilibria. However, Drs Lloyd and Freebairn have been swayed by Constable's experimental findings, in which the correlation of measured versus predicted pH was higher when total protein was used in the pH calculation rather than albumin alone.[7]

The attribution of trivalent charge behaviour to the divalent anions monohydrogen phosphate and sulphate, and to the divalent cations calcium and magnesium.

This tactic was adopted to track the known variation of these ions from 'ideal' behaviour.

Reporting individual effects on 'acidity' of each of the three independent variables (SID, A_{tot} and PCO_2).

Here Drs Lloyd and Freebairn introduce a novel concept, one which gives us a genuine feel for the relative impact of each of the independent variables on any given acid-base equilibrium. The calculator has been set up to report the theoretical offset in proton activity (in nmol/L) due to the abnormality in each variable, calculated at the actual values of the other two.

Changing the sign of the strong ion gap, and renaming it 'net unmeasured ions' or NUI.

To remain consistent with the anion gap convention, the strong ion gap is reported as though a positive value represents a predominance of unmeasured anions.[8,9] The Strong Ion Calculator reverses this long held practice, so that a negative NUI represents unmeasured anionic predominance. Such a change is undeniably logical, since it employs a negative sign to denote a negative charge. However, for acid-base newcomers already confronted by competing schools with chaotic nomenclature and conflicting conventions, the NUI concept will not improve matters.

Overall, the end result is an ingenious piece of software. My praise has one minor qualification. Drs Lloyd and Freebairn appear to conclude that with the Strong Ion Calculator there is no longer a need for acid-base 'rules of thumb'.[1] Here I beg to differ. On its own the Strong Ion Calculator cannot tell us whether a primary metabolic acid-base disturbance is compensated appropriately or whether there is an accompanying respiratory acid-base disturbance. By the same token, it does not of itself distinguish between acute and chronic respiratory acid-base disturbances. To make these calls, rules are required. This is just as true with the physical chemical approach as with the traditional approaches, although the rules need not be too complex.[10]

Nevertheless, Drs Lloyd and Freebairn are to be congratulated on developing an intriguing acid-base tool which answers a common criticism of the Stewart approach – its apparent lack of direct bedside application. The report generated by the Calculator breaks any acid-base equilibrium into its component parts, quantifying the respiratory and metabolic (both measured and unmeasured) contributions in a practical and clinically meaningful way. Critical care practitioners, perhaps even 'rusted on' acid-base traditionalists,[11] should find this a genuine advance.

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Indexation of the journal – further growth?

It is my pleasure to formally announce that *Critical Care and Resuscitation* has, following an application process to the National Library of Medicine (NLM), been indexed in Medline. The indexation commenced with the December 2005 edition of the Journal, but in time all previous editions of the Journal will also be indexed. Within a few months then authors of all articles, since the first edition in 1999, will be able to search for their articles published in the Journal via Medline. Of course authors of articles in the Journal have always been able to list their articles as publications, but they are now instantly verifiable on Medline.

The success of the application to the NLM for indexation is a tribute to the vision of the founding editor, and currently emeritus editor, Dr. L.I.G. (Tub) Worthley. His tenacity and hard work established the baseline from which the application could be made, namely a viable journal of good quality. A tribute is also due to all the authors who believed in the Journal and contributed over the past 6 years, despite the Journal not being indexed in Medline.

The Journal has taken two large steps in the past 12 months, firstly becoming the official journal of the Joint Faculty of Intensive Care Medicine (JFICM) and thereby increasing its circulation three-fold and secondly achieving indexation in Medline. The next step will be to move from in-house publication to a professional publisher. This will hopefully occur over the next 6 months. Clearly, as with editors the world over, I'd also like to see a further increase in the circulation to see more readers and contributors from around the world.

As it now stands, the Journal is an excellent forum for discussion via editorials, point of view papers, occasional essays and letters to the editor, which give the Journal warmth and liveliness. It also provides for the presentation of papers on the science and practice of critical care medicine (original papers, reviews and case reports). These contributions are available to a wide readership via the print version of the Journal, as well as via the website (www.jficm.anzca.edu.au). Hopefully Medline will now pave an even wider path to the Journal.

I look forward to being able to report more positive changes for the Journal in the near future.

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Chief Editor
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