

# Intensive care requirements for an ageing population – a microcosm of problems facing the NHS?

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**ABSTRACT** – The changing patterns of admissions to an intensive care unit (ICU) were investigated in relation to age. The local population and the patients admitted to ICU in each year from 1996 to 2002 were stratified by age. The trend in the ratio of admissions to population showed the most extreme changes in those aged  $\geq 60$  years. For this group, there was an increase of 2.62 admissions per 10,000 population per year (95% Confidence interval (CI) 1.41 to 3.85,  $p = 0.004$ ). APACHE II (Acute Physiology and Chronic Health Evaluation II) scores increased by 0.45 points per year (95% CI 0.16 to 0.74,  $p = 0.013$ ) and length of ICU stay increased by 0.21 days per year (95% CI 0.03 to 0.38,  $p = 0.032$ ). This rapid increase in the use of ICU resources by patients aged  $\geq 60$  years over a period of six years, combined with an ageing population, suggests that current projections of future ICU provision may be inadequate.

**KEY WORDS:** age, demand, elderly, intensive care

A major factor influencing future resource requirements in healthcare is the ageing of the population. In 1996, only 16% of the UK population was over 60 years old, but this is estimated to rise to 30%, ie 18.6 million, by 2031.<sup>1</sup> In the future, older patients are more likely to require access to all types of healthcare, including intensive care, because of associated comorbidities.<sup>2</sup> However, under 85 years, age *per se* does not predict poor outcome after intensive care unit (ICU) admission.<sup>3</sup> Today's society is less willing to accept barriers to treatment and the older population is, and is likely to become still more vocal in its demands for equal access.

## Methods

Between 1 April 1996 and 31 March 2002, we collected sociodemographic and severity of illness data on all admissions to the ICU of Portsmouth Hospitals NHS Trust, a district general hospital group serving approximately 550,000 people. Data were stored using specially designed software (WardWatcher®. Critical Audit Ltd).

## Intensive care unit data

The following data were retrieved for all patients aged  $\geq 60$  years: age, gender, APACHE II (Acute Physiology and Chronic Health Evaluation II) system,<sup>4</sup> acute physiology score, severity of illness score and predicted risk of hospital mortality, ICU length of stay (days) and ICU/hospital outcome (alive/dead). Patients' data were stratified into deciles of age, eg 0–9 years, 10–19 years, up to  $\geq 80$  years. The ratio of emergency to elective ICU admissions in the  $\geq 60$  years age group was also recorded for each study year.

Data relating to all admissions were used in the study, including those for patients readmitted to ICU during a single hospital stay, but not from patients readmitted daily for specific therapies, such as plasmapheresis. When calculating the hospital standardised mortality ratio (SMR) – the ratio of observed to expected deaths – only data from the first ICU admission in any one hospital stay were considered. Expected death rate was calculated by summing individual APACHE II risk of hospital mortality predictions.

## Population data

We obtained the number of patients registered on 1 April of each study year with general medical practices served by the Portsmouth Hospital NHS Trust, from the Portsmouth and South East Hampshire Health Authority. From these data, the ratio of ICU admissions ( $N_a$ ) to population ( $N_p$ ) for each age decile was calculated.

Regression curve analysis was performed using StatsDirect, thereby allowing linear curve estimation with 4 degrees of freedom.

## Results

Figure 1 compares the ratio  $N_a:N_p$  in 1996/7 to that for 2001/2. The most extreme changes in  $N_a:N_p$  occurred in those aged  $\geq 60$  years and those aged  $< 10$  years. The latter is explained by the opening of a regional paediatric ICU in early 1998. We have therefore concentrated on the changes found in those aged  $\geq 60$  years.

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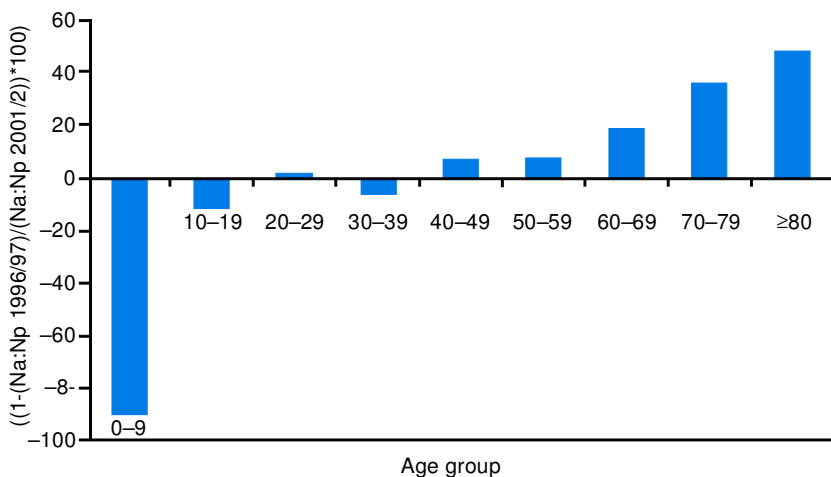
*Clin Med*  
2004;4:263–6

Table 1 shows that the 28% increase in total ICU admissions coincides with a 22% increase in bed numbers from 9 to 11. The ratio of emergency to elective admissions for the ICU was 3.54 (1996/7), 3.23 (1997/8), 3.04 (1998/9), 3.49 (1999/2000), 3.04 (2000/1) and 3.23 (2001/2).

Figure 2 shows a significant yearly increase in Na:Np of  $2.62 \times 10^{-4}$  (95% CI =  $1.41 \times 10^{-4}$  to  $3.84 \times 10^{-4}$ ,  $r^2 = 0.90$ ) for patients aged  $\geq 60$  years between 1996/7 and 2001/2. The proportion of admissions of patients in this age group to total ICU admissions increased significantly by 0.02 per year (95% CI = 0.01 to 0.03,  $p = 0.004$ ) (Fig 3).

The mean APACHE II acute physiology scores increased by 0.44 points per year (95% CI 0.12 to 0.76,  $r^2 = 0.78$ ). Mean APACHE II severity of illness score increased by 0.45 points per year (95% CI = 0.16 to 0.75,  $r^2 = 0.82$ ). Similarly, ICU length of stay increased by 0.21 days per year ( $p = 0.032$ , 95%CI = 0.03 to 0.38,  $r^2 = 0.72$ ). Hospital SMR remained almost unchanged. Total bed days occupied by those aged  $\geq 60$  years almost doubled from 1,102 to 2,116, a rise of 92%.

**Fig 1. Comparison of the ratio of ICU admissions to local population (Na:Np) for all age groups in years 1996/97 and 2001/02.**



The proportion of those aged  $\geq 60$  years in the total population served by our hospital increased by 0.67% annually.

## Discussion

We have shown that the ratio of ICU admissions to local population in people aged 60 years and above has risen linearly by 2.62 admissions per 10,000 population per year, over a period of six consecutive years. If all readmissions to ICU are excluded, the increase for this age group ( $p = 0.002$ , 95% CI= 1.54 to 3.46) is 2.5 admissions per 10,000 population per year. Consequently, the likelihood of admission for a local resident aged  $\geq 60$  years has risen linearly from 1 in 441 to 1 in 284. This age group represents an increasing proportion of ICU admissions – increasing by 2% per year. If such a rise continued until 2006/7, 69% of ICU admissions to our unit would be aged  $\geq 60$  years. These observations could be explained by the increased adult ICU capacity resulting from the opening of a regional paediatric ICU in 1998 and the expansion of total ICU beds by 22%. If this were

correct, it would be expected that the increase in workload would be spread relatively uniformly across all of the remaining age deciles. However, we found that the increased bed capacity was occupied predominantly by patients aged over 60 years.

One could postulate that the changes seen in ICU admission rate in this age group are due to a change in the casemix of patients, ie greater numbers of less sick patients. However, quite the opposite has occurred, with significant rises in the mean APACHE II acute physiology score, mean APACHE II severity of illness score and mean ICU length of stay. During the study period, there was no change in the ratio of emergency to elective patients in the  $>60$  years age group (3.54 in 1996/7, 3.23 in 2001/2;  $p = \text{NS}$ ) and there was no change in the admission policy of the ICU.

**Table 1. Yearly admissions, patients, ICU length of stay, total ICU bed days, mean APACHE II acute physiology scores (APS) and mean APACHE II severity of illness score.**

	1996/97	1997/98	1998/99	1999/00	2000/1	2001/2
ICU admissions	616	641	718	713	783	791
ICU patients	589	603	665	663	727	746
ICU admissions $\geq 60$ yrs	291	294	372	381	443	453
ICU patients $\geq 60$ yrs	280	274	343	348	404	426
People in the community $\geq 60$ yrs	117,409	117,904	118,935	119,548	120,553	121,230
Total bed days for patients $\geq 60$ yrs	1,103	1,135	1,469	1,840	1,998	2,116
Mean LoS for admissions $\geq 60$ yrs	3.79	3.86	3.95	4.83	4.51	4.67
Mean APACHE II APS for admissions $\geq 60$ yrs	13.088	14.801	14.737	15.065	15.348	15.911
Mean APACHE II scores for admissions $\geq 60$ yrs	18.155	19.807	19.713	20.076	20.316	20.954

APACHE II = Acute Physiology and Chronic Evaluation II; LoS = length of stay; APS = acute physiology scores.

Nevertheless, total ICU bed days almost doubled, from 1,102 to 2,116, representing a workload increase of 92%. This increased demand from this age group is greater than the increased proportion of the total population aged  $\geq 60$  years served by our hospital. Despite sicker patients and increased resource utilisation, the hospital survival rate for older ICU patients is no worse.

The reasons for the increased admission of older patients are unclear. A total of 146 extra patients  $\geq 60$  yrs were admitted in 2001/2 compared to 1996/97. As the Portsmouth ICU was a net exporter of critically ill patients throughout the study period, it is unlikely that our findings are an overestimate caused by the admission of patients from outside our own health district. For such practices to have an influence, our ICU would have to operate a selective approach, with patients being selected for transfer on the basis of age. An additional 730 annual bed days were available at the end of the study, compared to the beginning, due to the opening of two extra ICU beds. In the same period, the elderly population alone used more than 1,000 extra bed days, supporting the evidence that the observed increase in bed utilisation by the  $\geq 60$  yrs age group was real.

Similar trends to ours have been noted elsewhere. One UK ICU reported a year-on-year increase in the mean age of admissions over five years.<sup>5</sup> Additionally, a Swiss study showed that the increase in surgical and anaesthetic activity in patients  $>65$  years was significantly higher than the increase in this age group in the general population over a 10-year period.<sup>6</sup>

Society now appears less likely to accept a paternalistic model of healthcare. Powerful political groups are already campaigning against ageism in the NHS<sup>7</sup> and the National Service Framework for Older People supports this.<sup>8</sup> There are also recent examples of changing clinical practice affecting the elderly, eg the national advice regarding cardiopulmonary resuscitation.<sup>9</sup> Nevertheless, much research suggests that ageism is widespread in healthcare, influencing decisions to deny access to cardiological and neurosurgical investigations,<sup>10–11</sup> dialysis,<sup>12–13</sup> ventilation and surgery.<sup>13</sup> Age alone has also been shown to influence decisions to admit hypothetical cases to an ICU.<sup>14</sup>

Even though ICU mortality increases with age, older patients do benefit from ICU admission because severity of illness is a more important factor.<sup>3,15–18</sup> ICU mortality for those aged  $>65$  years has been reported as 36.8%<sup>3</sup> and survival of 70- to 84-year-olds at one year following intensive care is as high as 56%.<sup>15</sup> However, these figures are worse in those aged over 85 years, where survival at one year is 23%.<sup>17</sup>

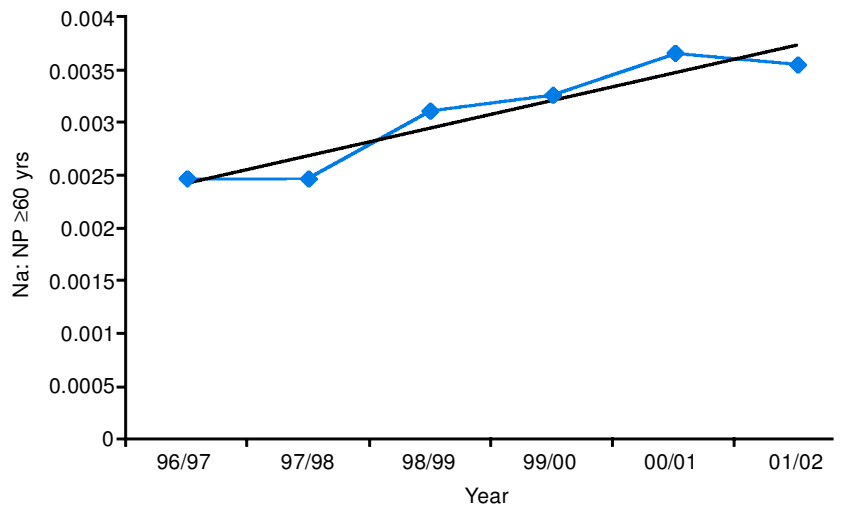
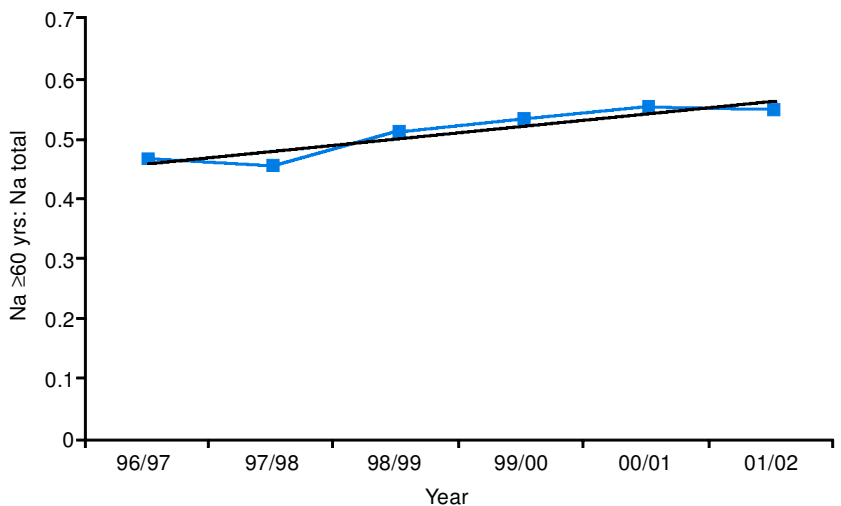


Fig 2. Ratio of admissions (Na) to population (Np) for those aged  $\geq 60$  years (◆) over time, with line of best fit shown.

Whatever the reasons behind the increased demand for intensive care by those aged  $\geq 60$  years, the rise poses a huge challenge to healthcare providers. In 1998, it was estimated that the adult ICU provision in England was 55 beds per million.<sup>19</sup> Following public and political disquiet over the lack of ICU beds and a high volume of patient transfers, the UK Government pledged to increase critical care capacity. By 2002, it had already reached its target of a 30% increase from the January 2000 figure. Although laudable, this increase is unlikely to be adequate in view of our findings. The Department of Health document, *Comprehensive critical care* (August 2000),<sup>20</sup> includes a calculation estimating critical care bed requirements based on prior demand. At the same time, data from Wales<sup>19</sup> were used to estimate critical care resources for a hospital serving 600,000 people. It is likely that such data were used to support the level

Fig 3. Proportion of ICU admissions aged  $\geq 60$  years to total ICU admissions over time (■), with line of best fit shown.



## Key Points

### Healthcare demand increases with age

The UK population is ageing, with 30% estimated to be above 60 years of age by 2031

In recent years the demand for ICU resources from those aged ≥60 years has risen significantly

The occupancy of ICU beds by the elderly is growing faster than their prevalence in the resident population

Future ICU provision may need to be substantially increased above that already achieved by recent investment

of recent investment in ICU resources. However, the changes demonstrated by our study do not appear to have been incorporated into these analyses. Importantly, our data do not take into account the expected future rise in the percentage of the UK population aged >60 years.<sup>1</sup> Furthermore, the additional demand demonstrated in Portsmouth may be an underestimate, since the population served by our trust has fewer retired people (17.4 vs 18.1%) than the national average.<sup>1</sup> Therefore future critical care provision must accommodate not only the effects of the population over 60 almost doubling, but also a significant and apparently rapidly rising demand from this age group.

Few of the population require ICU admission, and therefore intensive care represents a small proportion of the total NHS workload. It is likely that the changes described here could be seen in almost any other clinical field, with even greater resource implications. Therefore, the finding that the elderly ICU population in intensive care is growing faster than its prevalence in the resident population is a warning for the future development of the whole of healthcare in this country.

### Acknowledgements

The authors wish to acknowledge the assistance of Mrs. Val Walker, audit clerk, ICU of Portsmouth Hospitals NHS Trust, Dr. Martin Tweeddale, Clinical Director for Critical Care at Portsmouth Hospitals NHS Trust and Mr. Bernie Higgins, Department of Statistics, University of Portsmouth.

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