Comparison of medical admissions to intensive care units in the United States and United Kingdom

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At a glance commentary:

Scientific knowledge on the subject: There are seven times as many adult ICU beds per capita in the US versus the UK. Little is known about the effect of differences in availability of ICU beds on the delivery of critical care.

What this study adds to the field: Case mix and patterns of care among medical ICU admissions differ dramatically in the US and UK, with many fewer patients admitted directly from emergency rooms in the UK, and a much higher severity of illness on admission to ICU. Discharge patterns are markedly different, with longer hospital stays for patients in the UK, but a much greater reliance on discharge to skilled care facilities in the US. These differences in discharge practice confound interpretation of hospital mortality across countries.

Authorship:

KR and DA conceived the idea

All authors drafted the analysis plan

HW, WL-Z and DH performed the analysis

All authors interpreted the data

All authors wrote and commented on the manuscript

This article has an online data supplement, which is accessible from this issue's table of contents online at www.atsjournals.org.

ABSTRACT

Rationale: The US has seven times as many intensive care unit (ICU) beds per capita as the UK; the effect on care of critically ill patients is unknown.

Objective: Compare medical ICU admission in the US and UK.

Methods: Retrospective (2002-2004) cohort study of 172,785 admissions (137 US ICUs, Project IMPACT database; 160 UK ICUs, UK Case Mix Programme), with patients followed until initial hospital discharge.

Results: UK (*vs* US) admissions were less likely to be admitted directly from the emergency room (ER), (33.4 *vs* 58.0%), had longer hospital stays before ICU admission (mean days 2.6±8.2 *vs* 1.0±3.6), and fewer were ≥85 years (3.2% *vs* 7.8%). UK patients were more frequently mechanically ventilated within 24h after ICU admission (68.0% vs 27.4%), were sicker (mean Acute Physiology Score 16.7±7.6 vs 10.6±6.8), and had higher primary hospital mortality (38.0% vs 15.9%; adjusted Odds Ratio (OR) 1.73, 95%CI 1.50-1.99). There was no mortality difference for mechanically ventilated patients admitted from the ER (adjusted OR 1.09, 0.89-1.33). Comparisons of hospital mortality were confounded by differences in casemix, hospital length of stay (UK median 10 days (IQR 3-24) vs US 6 (3-11)), and discharge practices: more US patients were discharged to skilled care facilities (29.0% of survivors *vs* 6.0% in the UK).

Conclusions: Lower UK ICU bed availability is associated with fewer direct admissions from the ER, longer hospital stays before ICU admission, and higher severity of illness. Interpretation of between-country hospital outcomes is confounded by differences in casemix, processes of care and discharge practices.

Keywords: Critical Care, Intensive Care Unit, United States, United Kingdom, Mechanical Ventilation

Although integral to healthcare systems in developed countries, intensive care services are provided quite variably across countries [1,2]. In the United States, expenditure on intensive care now makes up approximately 13% of hospital costs and 0.7% of the Gross Domestic Product (GDP) [3], with mounting concerns regarding the high costs of intensive care services, and increasing use of mechanical ventilation [4,5]. In contrast, expenditure on intensive care services in the United Kingdom represents less than 0.1% of the GDP [6,7].

The US and UK have very similar acute hospitalization rates per capita, but we recently demonstrated a large difference in the number of intensive care unit (ICU) beds, with a seven-fold higher rate of ICU beds per capita in the US,[1] and approximately 20% of acute hospital admissions receiving intensive care in the US compared with only 2% in the UK [8]. However, we do not know the impact of different resources and spending on the delivery of intensive care. In particular, frequent speculation centers on whether fewer ICU resources lead to inclusion of only patients with high severity of illness, and age-based admissions policies [9]. We therefore sought to compare the impact of very different absolute intensive care resources on both the characteristics and outcomes of medical ICU admissions. Some of the results of these studies have been previously reported in the form of abstracts [10,11].

MATERIALS AND METHODS

Creation of a US-UK dataset

For these analyses, we required datasets that included detailed information on all patients in the ICU, including raw data for derivation of severity of illness measures. We therefore chose to use data from Project IMPACT (PI) (Cerner, Kansas City, MO) for the US and from the Intensive Care National Audit & Research Centre (ICNARC) Case Mix Programme (CMP) for the UK. Both sets of data were collected prospectively and abstracted from the clinical record by trained data collectors, according to precise rules and definitions. Data were extensively validated both locally and centrally. Data from both countries were from ICUs that participated voluntarily, paying a set fee per year (although five to ten times lower in the UK) to the central organization for comparative audit purposes. More detailed information on PI and the CMP have been published previously [12,13]. The majority of ICUs in the UK are mixed medical-surgical, while many of the US ICUs are either stand-alone medical or surgical units. For further details regarding representativeness of data, see Online Data Supplement A.

We merged PI and CMP data to create a US-UK database. Using users' guides and data collection manuals, we incorporated only those variables confirmed to be defined similarly in both countries. For variables that involved multiple categories (e.g. location of patient prior to admission to ICU), we collapsed available options to the lowest common denominator of options between PI and CMP. The diagnoses on admission to ICU were condensed down to the original Acute Physiology And Chronic Health Evaluation II (APACHE II) diagnostic categories [14]. Initial decisions were made by one author (HW) and then reviewed by three other authors (DA, KR, DH). We resolved any disagreement through discussion with all authors.

Exclusions

We included all medical admissions to primarily medical, surgical or mixed medical-surgical ICUs from 2002 to 2004. Some of these ICUs in the UK included high-dependency unit (HDU) beds as well, and some (in both countries) included coronary care unit beds. We excluded surgical admissions, defined as those admitted directly from the operating room/theatre or post-operative recovery room. We did not examine surgical admissions to ICU because of the potential for admission patterns to be influenced by different decisions regarding the need for surgery in the first place, as well as the skills of particular surgeons and other options for post-surgical care. We excluded admissions less than 16 years, and readmissions to ICU during the same acute hospital stay (see Figure E1 in Online Data Supplement B).

Description of Severity of Illness

To assess the severity of illness of patients admitted to the ICU, we calculated Acute Physiology Scores (APS), and APACHE II scores using a standard adaptation of the original US scoring system for all admissions [14]. These scores were already available in each dataset, but were re-calculated for this study to ensure that the exact same algorithm was used in the calculation. We excluded admissions staying less than eight hours in ICU and burn admissions from these calculations (see Online Data Supplement B, Table E1). One variable in particular, oxygenation, was not measured in the majority of US ICU patients who were not receiving mechanical ventilation. We used the standard rules for missing data, as per the original APACHE II method, assigning normal values. For details regarding the components of the APACHE II scores and missing data in the two countries, see Online Data Supplement C.

Differences in Patient Characteristics

We assessed characteristics of admissions to ICUs in the two countries specifically to determine whether there were large differences in age and severity of illness of patients. We present summary statistics as percentages, means with standard deviation (±sd), and medians with inter-quartile ranges (IQR), where appropriate. We examined all patients and also sub-divided them in two ways: (1) by whether or not they were mechanically ventilated within the first 24 hours after admission to ICU - we chose this sub-group analysis in order to examine patients in the two countries who were potentially more homogeneous with respect to both overall severity of illness and primary diagnoses [15]; and (2) by APS – we chose this sub-group analysis in order to examine resource use and outcomes stratified by a standard acute severity of illness descriptor that does not incorporate age, while recognizing that similar APS may represent different risk of mortality across different primary diagnoses.

Patterns of care

We examined where patients were admitted from (emergency room, hospital floor, ICU of another hospital, or 'other'), for the whole cohort, and also stratified by select APACHE II diagnostic categories. We examined whether patients admitted to ICU in the UK had a longer length of stay in the acute hospital prior to, during, or after admission to ICU. We summarized median (with interquartile range) and mean lengths of stay (±sd) for all patients, and stratified by whether they survived to ICU/acute hospital discharge or died. We also stratified patients by severity of illness, and whether or not they survived to acute hospital discharge. Differences between groups were assessed using the Kruskal-Wallis and t-test as appropriate.

Hospital Mortality and Discharge Status

We calculated unadjusted ICU and acute hospital mortality (measured at the point of discharge from the acute hospital where the initial ICU admission occurred, which we refer to as the "primary" hospital mortality throughout) for the whole cohort and stratified by the Acute Physiology Score. We then performed risk-adjustment using the components of the APACHE II score (APS, chronic health points, age), as well as other variables that were available and are associated with outcome (location prior to ICU admission, primary diagnosis on ICU admission, mechanically ventilated within 24 hours after ICU admission, cardio-pulmonary resuscitation in the 24 hours prior to ICU admission, hospital length of stay prior to ICU admission, number of ICU beds, and type of hospital – university, university-affiliated, non-university) with clustering to account for between ICU variation. We created risk-adjusted models for the entire cohort, and then for sub-sets of patients who might be more homogeneous: patients mechanically ventilated within 24 hours after ICU admission, and then only those patients mechanically ventilated who were admitted directly from an emergency room. We also examined mechanically ventilated patients in specific APACHE II diagnostic categories. Categories were omitted if considered too heterogeneous (i.e. "general cardiac"). Models were tested using the Hosmer-Lemeshow goodness-of-fit statistic and the area under the Receiver Operating Characteristic curve.

We summarized the destination of patients on discharge from the acute hospital where the initial ICU admission occurred (as discharged to another acute hospital, skilled care facility, or normal residence). P-values were considered significant if ≤ 0.05. All statistical analyses were performed using Stata 10.0 (StataCorp LP, College Station, TX, USA). Approval for this study was sought and received from the Institutional Review Board at Columbia University.

RESULTS

Admission characteristics

The US-UK dataset contained 172,785 admissions to 137 US ICUs (n=102,346) and 160 UK ICUs (n=70,439). The ICUs in the US sample had, on average, more ICU beds than those in the UK sample (Table 1). More ICUs in the UK sample (27.0%) were in a university hospital compared with the US (12.4%, P<0.001).

Overall, the patient age distribution was similar in the two countries, with a slightly higher mean age in the US (60.4 years ±18.6 versus 57.4 ±18.8 in the UK, P<0.001). Proportionally, there were twice as many patients aged 85 and older in the US ICUs (7.8% versus 3.2% in the UK, P<0.001) (Figure 1a). The mean APS among medical admissions in the US was substantially lower than in the UK (10.6 ±6.8 US versus 16.7 ±7.6 UK, P<0.001, Figure 1b). However, when we restricted our analysis to only those admissions ventilated within the first 24 hours after ICU admission, the APS distributions were more similar (15.3 ±7.8 in the US and 18.5 ±7.4 in the UK, P<0.001). The same patterns were evident using the full APACHE II score, which includes additional points for both age and for the presence of severe chronic health conditions (Figure 1c, Table 1).

The US admitted a higher percentage of admissions with “any severe, chronic medical conditions”, as defined by the original APACHE II method, (25.9% versus 14.0%, P<0.001), but twice as many admissions in the UK had received CPR in the 24 hours prior to admission as in the US (10.4% UK versus 4.4% US, P<0.001) (Table 1). The distribution of primary diagnoses was slightly different between the two countries, with cardiac diagnoses predominant in the US (42.2%), and almost one tenth (8.9%) admitted with a primary diagnosis of either coronary artery disease or acute myocardial infarction in the US (versus 1.6% in the UK, P<0.001). Respiratory and cardiac diagnoses were equally common in the UK. Similar percentages were treated for trauma (4.2% in the US versus 3.9% in the

UK, P=0.001). More than half (53.7%) of medical patients in the UK were mechanically ventilated on admission compared with only a fifth (21.1%) in the US (Figure 2). An additional 14.3% of patients in the UK were intubated and mechanically ventilated within the first 24 hours after admission to the ICU, compared with 6.3% of US patients (P<0.001).

Patterns of care

While the median hospital length of stay prior to ICU admission was zero days in both countries, the mean was substantially different (1.0 ±3.6 days in the US versus 2.6 ±8.2 in the UK, P<0.001) (Table 1). Almost twice as many US admissions were admitted to the ICU directly from the emergency room (58.0% US versus 33.4% UK, P<0.001) with fewer from hospital floors (17.5% US versus 36.9% UK, P<0.001) (Table 1). The UK admitted fewer patients directly from the emergency room for all diagnoses and across all of select APACHE II diagnostic categories (Figure 3). A greater percentage of those direct emergency room admissions were mechanically ventilated within 24 hours of admission to the ICU in the UK. Both median and mean total ICU and hospital stay were slightly longer in the UK than in the US (Table 2). Sub-divided by APS and whether or not patients survived to acute hospital discharge, UK and US ICU patients had a longer (median) ICU stay, as severity of illness increased (Figure 4). For acute hospital survivors, no matter the severity of illness, the median length of stay in the hospital was markedly longer in the UK, particularly after discharge from the ICU.

Hospital outcomes

The unadjusted ICU and primary hospital mortality for medical admissions were substantially higher in the UK compared with the US (primary hospital mortality 38.0% UK versus 15.9% US, P<0.001, Table 2). Differences in primary hospital mortality for the whole cohort remained after adjustment for measured risk-factors (adjusted Odds Ratio (aOR) 1.73, 95% CI 1.50-1.99, Table 3) . Adjusted odds of primary hospital mortality between the countries varied based on the APS of the patients, with a higher risk of death in the UK for patients with low APS, and lower risk for patients with a high APS (Figure 5). Comparison of more homogeneous groups led to more similar adjusted OR: for UK patients who were mechanically ventilated in the first 24 hours after admission to ICU, aOR 1.41, 95% CI 1.23-1.62. For patients admitted directly from the emergency room and mechanically ventilated on admission within 24 hrs of admission to ICU, there was no difference between groups: aOR 1.09, 95% CI 0.89-1.33 (Table 3). Comparison of risk-adjusted primary hospital mortality among mechanically ventilated patients with specific APACHE II diagnoses demonstrated a range of odds ratios, with the majority not statistically different between the two countries (Table 3).

Comparison of the hospital mortality was clearly confounded by hospital discharge destination patterns. Among survivors of the primary acute hospitalization, 29.0% in the US were discharged to a skilled care facility (versus 6.0% in the UK, P<0.001), (Table 2), with many more transfers to other acute care hospitals in the UK (23.0% versus 6.1%, P<0.001). Stratified by APS, the percentage of patients discharged to skilled care facilities rose substantially in the US as severity of illness increased, up to 53.9% for survivors with APS greater than 20 (compared with 7.9% of UK survivors with the same severity of illness, P<0.001) (Figure 6). A much greater proportion of survivors with a high APS were discharged to their normal residence in the UK versus the US.

DISCUSSION

The choices surrounding the delivery of intensive care must be distinct in two countries with a seven-fold difference in the number of adult ICU beds per capita. Examination of patient care patterns that emerge from these differences is warranted given current debates over optimal provision of healthcare resources. The methodological challenges of cross-national comparisons are large, and we were particularly hampered by the difficulty of using available datasets that were not originally designed for such comparisons. Despite these limitations, this study elucidates important, detailed information regarding the impact of different resources on the delivery of intensive care services in two developed countries, as well as the challenges of comparisons.

Medical patients admitted to the ICU in the US had a much lower severity of illness, were much less likely to be intubated on arrival to the ICU, and were much more likely to be admitted directly from an emergency room, rather than the hospital floor, consistent with a picture where the threshold for admission in the US is lowered substantially with many more available beds. While there were only small differences in the overall age distributions of patients, the very elderly represented a much larger proportion of admissions in the US.

We have demonstrated not only large differences in case mix, but also substantial differences in post-ICU care, including differences in lengths of stay in the hospital, likely reflecting the early, frequent use of skilled nursing facilities in the US, especially among patients with a high severity of illness. These large systems differences demonstrate the difficulty of accurately comparing outcomes in multi-national studies, and highlight the need for future studies that include data on all hospital admissions and also allow for follow-up beyond discharge from the primary acute hospital. No such database currently exists (in either country) with the requisite clinical detail and follow-up.

With such a large difference in ICU beds per capita in the US and UK, many people are clearly admitted to ICU every year in the US who would not be admitted in the UK. The differences in number of comorbidities was substantially greater in the US group. However, it is important to note, that coding of chronic health conditions is an area with large potential for systematic biases, since reimbursement is more likely to be influenced by coding in the US than in the UK. Even assuming the potential difference in burden of illness is real, and taking it into account, the admission rates to intensive care still remain disparate. Some prior studies have tried to examine this question of the outcomes for patients denied admissions to ICU [16-18]; a systematic review of the topic looking at rationing of intensive care beds included ten observational studies and found that refusal was associated overall with an increased risk of hospital death [9]. These types of triage decisions seem likely to occur more in the UK. However, in the US, some of these triage decisions may never get made, as many citizens remain uninsured, with decreased access to hospital care in general [19].

For ICU patients, the findings of differences on admission, of course, translate into large differences in outcomes. Unadjusted, and casemix adjusted hospital mortality are higher overall in the UK compared with the US. This is not surprising, and has been reported in many publications [20,21]. Our data begin to explain the reasons for these differences, demonstrating the variation in association between severity of illness and outcomes in the two countries, with lower hospital mortality in the US for low-risk patients, and lower hospital mortality in the UK for very high-risk patients. Variation in outcomes when stratified by severity of illness has been previously reported in comparisons of ICU patients across countries [22]. These variations are likely due to unmeasured selection biases associated with the decision to admit patients with similar physiology that cannot be adequately adjusted for using regression models. This is further demonstrated by the fact that comparison of more homogenous populations (such as patients admitted directly from the emergency room who are mechanically ventilated) yields adjusted hospital mortality that are remarkably similar in the two countries.

We also show that the persistent overall increased mortality risk in the whole UK cohort is likely due to factors at the admission and discharge ends of ICU care. The effect of the limited availability of ICU beds in the UK is visible in both the high percentage of admissions already intubated on arrival in the ICU, as well as the longer time between acute hospital admission and ICU admission (fewer patients admitted directly from an emergency room) which may affect the degree of severity of illness of patients when finally admitted.

On the other end, clear differences exist in discharge patterns related to the different structuring of healthcare in the two countries. US ICU admissions appear to have relatively short lengths of stay in the primary hospital, with a high use of skilled care facilities allowing for early discharge – a pattern also noted in other studies [23,24]. Admissions who are discharged to skilled care are known to have much higher mortality in the weeks and months that follow [25-27], so comparison of only primary acute hospital mortality, without any follow-up beyond discharge to a specific time point, must be viewed with extreme caution. In particular, mechanically ventilated patients fare poorly in the US after hospital discharge [27]. Many more patients in the UK were also transferred to other acute care hospitals, highlighting the difficulty of comparison. However, the additional mortality accrued with these hospital transfers is actually minimal, with an increase of only 2% in total mortality reported with CMPD data [13].

In our cohort, discharge to hospice was only flagged in the US data, so all such discharges were placed in the “skilled care” category. However, discharges to hospice represent only a tiny proportion of all US discharges [26]. Cultural norms and preferences with regard to end-of-life care, as well as what constitutes a quality of life that is considered acceptable, may also differ, leading to higher mortality for some or all sub-groups in each country.

Recent data demonstrate improvements in mortality associated with intensive care admissions in the UK, starting in 2000 with efforts to "modernise" adult critical care with an increase in the number of ICU beds, as well as focusing on integrating critical care with other acute care services in the hospital [28]. These changes have resulted in an average decrease of 2.6% per year, and a decrease in average length of stay of 0.04 days per year. We were limited in our ability to assess the impact of these changes on comparisons with the UK due to the timing of the changes. However, the magnitude of the shifts, while important, are unlikely to change the overall findings of this study, given the continuing magnitude of the differences in ICU bed availability and discharge patterns.

This study has a number of limitations, including lack of data on patients not admitted to the ICU, and long-term follow-up. As well, these data are from two separate clinical datasets. Although we made every effort to ensure similarity in collection methods used, and comparability of definitions, it remains possible that for some variables there were still differences in these aspects of the data between the two countries. In particular, one of the variables for calculation of the APS was missing frequently in the US data. While this is likely due to the overall low severity of illness of these patients (reflected in the fact that no blood gas was drawn) we are potentially slightly underestimating the APS in some of these US patients, and therefore underestimating the risk-adjusted differences between the countries in primary hospital mortality.

Even the definition of an intensive care bed may vary between the two countries, as some data in each country may include patients who only require intermediate, or "high-dependency" care, rather than full intensive care [1]. Our two datasets provide a different level of representativeness in the two countries, with much greater coverage in the UK compared with the US. There are some subsets of ICUs in the US that are under-represented. If anything, we are likely to have overestimated the severity of illness of US ICU admissions, as PI has a large precentage of big, urban hospitals in comparison with the country as a whole (see Online Data Supplement A), which tend to care for a higher volume of mechanically ventilated, severely ill patients [29]. Certainly, in comparison with other data sources, such as Medicare, the hospitals in Project IMPACT appear to have more patients who receive mechanical ventilation, and higher hospital mortality [27]. We chose to use PI rather than other available data sources for US ICU patients, due to the much greater breadth of information available in PI, specifically with regard to physiologic data and overall severity of illness. We also do not have information on non-invasive mechanical ventilation, which may have substantially increased in use during this time period, both as an adjunct and as a replacement for invasive mechanical ventilation [30]. Another limitation is that we cannot measure the actual decision-making of the physicians, merely some of the consequences of different myriad competing interests that are balanced by all clinicians when caring for critically ill patients.

Many may view the two countries examined in this study as representing either extreme with regard to health care in the developed world – unnecessary excess in expenditure in the US and under-funding and frugality in the UK. In particular, the incentives for providing higher level care are substantially different, with concern in the US regarding the potential monetary incentives for additional tests or procedures that may alter care patterns [31].Yet, on many indices used to examine quality of care, these two countries remain similar, or have outcomes that differ from the expected findings. For example, infant mortality is consistenly higher in the US and overall life expectancy is similar, despite a much higher spending on health care per capita, suggesting that differences in spending do not always translate into results as expected [32]. The different provision of intensive care, and the subsequent differences in case mix and outcomes for patients in the ICU in the US and UK provides stark data regarding the different choices made in two countries in attempts to optimise the use of expensive, invasive technology. It remains unclear whether either country has found a true balance, and further research is needed to establish what constitutes effective, cost-efficient intensive care.

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ROLE OF THE FUNDING SOURCES

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POTENTIAL CONFLICT OF INTEREST

None.

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FIGURE LEGEND

Figure 1. – Distribution of the (a) age, (b) Acute Physiology Scores, and (c) APACHE II scores for all medical admissions to the ICU

Figure 2. Breakdown of the medical admissions in the US and UK by whether or not they were mechanically ventilated on admission or in the first 24 hours after admission to ICU

Figure 3. Percentage of ICU admissions that are admitted directly from the emergency room, for all medical admissions, and for select APACHE II diagnostic categories, stratified by mechanical ventilation on admission to ICU.

Figure 4. Length of stay before, during, and after admission to the ICU (median days), stratified by severity of illness (Acute Physiology Score)

Figure 5. Unadjusted odds ratios for primary acute hospital mortality for medical ICU patients in the UK versus US stratified by severity of illness (Acute Physiology Score) of patients on admission to ICU

Figure 6. Destination at primary hospital discharge for medical admissions who survived to hospital discharge, divided by severity of illness (Acute Physiology Score)

Table 1. – Characteristics of medical admissions to general ICUs in the US and UK

	US	UK	p-value
Number of hospitals	109	160	
Number of ICUs	137	160	
University ICU, %	12.4	27.0	<0.001
University affiliated ICU, %	56.4	17.2	<0.001
Number of ICU beds, median (IQR)	15 (12-20)	7 (6-9)	<0.001
Number of admissions	102,346	70,439	
Age, mean ±sd	60.4 ±18.6	57.4 ±18.8	<0.001
Sex, % male	53.8	56.3	<0.001
Source of admission to ICU, %			
Emergency room	58.0	33.4	<0.001
Hospital floor	17.5	36.9	
Other hospital, ICU	1.8	6.1	
Other	22.7	23.6	
Hospital length of stay prior to ICU, median (IQR)	0 (0-1)	0 (0-2)	<0.001
Hospital length of stay prior to ICU, mean (±sd)	1.0 ±3.6	2.6 ±8.2	<0.001
Chronic Medical Conditions (any), %	25.9	14.0	<0.001
CPR in 24 hours prior to admission, %	4.4	10.4	<0.001
MV on admission to unit or in first hour, %	21.1	53.7	<0.001
MV within first 24 hours after admission to unit, %	27.4	68.0	<0.001
Coma or deep stupor on admission to unit, %	7.1	13.9	<0.001
Intracranial mass effect on admission to unit, %	4.2	5.1	<0.001
Acute Physiology Score, mean ±sd*			
All admissions	10.6 ±6.8	16.7 ±7.6	<0.001
MV within first 24 hrs after admission to ICU	15.3 ±7.8	18.5 ±7.4	<0.001
APACHE II Score, mean ±sd**			
All admissions	15.3 ±8.0	20.5 ±8.5	<0.001
MV within first 24 hrs after admission to ICU	20.1 ±8.9	22.3 ±8.2	
Primary diagnostic category on admission			
Cardiac	44.6	27.1	<0.001
CAD & AMI	8.9	1.6	
Congestive heart failure	4.2	2.9	
Rhythm Disturbance	2.4	0.9	

Cardiogenic Shock	0.4	0.9
Trauma	4.2	3.9
Respiratory	20.1	26.3
Neurologic	19.1	24.1
Gastrointestinal	10.1	9.5
Metabolic & Renal	6.1	11.5
Burns	0.6	0.4
Unknown	0.0	0.6

ICU = Intensive Care Unit, CPR = cardio-pulmonary resuscitation, APACHE II = Acute Physiology Age and Chronic Health Evaluation II score, IQR = inter-quartile range, sd = standard deviation, CAD = coronary artery disease, AMI = acute myocardial infarction, MV = mechanically ventilated

*n=10,067 excluded based on standard eligibility for APACHE II score calculations

**n=10,092 excluded based on standard eligibility for APACHE II score calculations and/or missing all data for calculation of Acute Physiology Score

Table 2. – Length of stay and primary hospital outcomes for medical admissions to general ICUs in the US and UK

	US	UK	p-value
ICU length of stay (days), median (IQR)	1.9 (1.0-3.8)	2.5 (0.9-6.6)	<0.001
ICU length of stay (days), mean (±sd)	3.5 ±5.2	5.8 ±10.1	<0.001
Primary acute hospital length of stay (days), median (IQR)	6 (3-11)	10 (3-24)	<0.001
Primary acute hospital length of stay (days), mean (±sd)	9.4 ±11.7	19.3 ±27.9	<0.001
ICU mortality, %	10.3	29.2	<0.001
Primary acute hospital mortality, %	15.9	38.0	<0.001
Survivors destination after discharge from ICU, %			
Floor	66.5	66.3	<0.001
Intermediate care	17.8	15.7	
Other	15.7	17.7	
Survivors destination after discharge from primary hospital, %			
Another acute hospital	6.1	23.0	<0.001
Skilled care facility	29.0	6.0	
Normal residence	64.8	71.0	

ICU = Intensive Care Unit, IQR = interquartile range, CI = confidence interval, MV = mechanical ventilation, ER = emergency room, APACHE II = Acute Physiology Age and Chronic Health Evaluation II score

Table 3. – Risk-adjusted primary hospital mortality for medical admissions to general ICUs in the UK compared with US for the full cohort and sub-groups of patients

	Number	Adjusted Odds Ratio for primary hospital mortality (UK compared with US)	95% CI	P Value
Full cohort*	135,092	1.73	1.50-1.99	<0.001
Excluding cardiac diagnoses**	118,328	1.65	1.43-1.90	<0.001
Mechanically ventilated (in first 24hrs in ICU)	64,042	1.41	1.23-1.62	<0.001
Admitted directly from ER	27,909	1.09	0.89-1.33	0.42
Select APACHE II diagnostic categories				
Hemorrhagic shock	443	1.12	0.58-2.17	0.74
Post-cardiac arrest	10,081	1.17	0.93-1.48	0.19
Respiratory infection	8,026	2.30	1.90-2.79	<0.001
Pulmonary embolism	278	1.02	0.43-2.42	0.97
Toxic or chemical poisoning	1,392	1.82	1.22-2.70	0.003
Aneurysm/PVD	401	1.46	0.63-3.35	0.38
Neurological hemorrhage	4,350	0.74	0.55-0.99	0.044
Gastrointestinal bleed	1,186	1.85	1.16-2.93	0.009
Seizures	2,258	0.56	0.36-0.85	0.007
Allergic reaction	1,122	3.00	0.57-15.85	0.20
Diabetic ketoacidosis	401	1.81	0.70-4.64	0.22
Head Trauma	2,447	0.83	0.57-1.21	0.32
Overdose	4,494	0.86	0.48-1.53	0.60
Trauma	2,569	0.87	0.54-1.38	0.55

MV = mechanical ventilation within 24 hours after admission to ICU, ICU = intensive care unit, ER = emergency room, PVD = peripheral vascular disease, APACHE II = Acute Physiology Age and Chronic Health Evaluation II score

*Excludes patients with burns, acute MI, and those staying in the ICU for less than 8 hrs. Adjusted for: acute physiology score, APACHE II chronic health points, age, CPR within 24 hours prior to ICU admission, location immediately prior to ICU admission, primary APACHE II diagnostic category, mechanically ventilated within 24 hours after ICU admission, length of stay in the hospital prior to ICU admission, size of ICU, type of hospital (university, university affiliated, non-university), with clustering by ICU. Hosmer-Lemeshow goodness-of-fit P<0.001, area under the Receiver Operating Characteristic curve (AU-ROC) = 0.86. **Excludes general cardiac, congestive heart failure, hypertension, rhythm disturbances, and cardiogenic shock. Hosmer-Lemeshow goodness-of-fit P<0.001, AU-ROC 0.85; for MV model: P<0.001, AU-ROC 0.82; for MV & ER only model: P=0.032, AU-ROC 0.86.