

Rosalind Elliott
Sharon McKinley
Leanne M. Aitken
Joan Hendrikz

The effect of an algorithm-based sedation guideline on the duration of mechanical ventilation in an Australian intensive care unit

Received: 19 December 2005
Accepted: 30 June 2006
Published online: 8 August 2006
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R. Elliott (✉)
The Royal North Shore Hospital, Intensive
Care Unit,
Sydney, NSW 2065, Australia
e-mail: rmelliot@nscchahs.health.nsw.gov.au
Tel.: +61-2-99267853
Fax: +61-2-94398418

S. McKinley
The Royal North Shore Hospital and The
University of Technology, Critical Care
Nursing, Intensive Care Unit,
Sydney, Australia

L. M. Aitken
Griffith University and Princess Alexandra
Hospital, Critical Care Nursing, Research
Centre for Clinical Practice Innovation,
Brisbane, Australia

J. Hendrikz
The University of Queensland, Statistics,
CONROD, Mayne Medical Centre,
Brisbane, Australia

Abstract *Objective:* To examine the effect of an algorithm-based sedation guideline developed in a North American intensive care unit (ICU) on the duration of mechanical ventilation of patients in an Australian ICU. *Design and setting:* The intervention was tested in a pre-intervention, post-intervention comparative investigation in a 14-bed adult intensive care unit. *Patients:* Adult mechanically ventilated patients were selected consecutively ($n = 322$). The pre-intervention and post-intervention groups were similar except for a higher number of patients with a neurological diagnosis in the pre-intervention group. *Intervention:* An algorithm-based sedation guideline including a sedation scale was introduced using a multifaceted implementation strategy. *Measurements and results:* The median duration of ventilation was 5.6 days in the post-intervention

group, compared with 4.8 days for the pre-intervention group ($P = 0.99$). The length of stay was 8.2 days in the post-intervention group versus 7.1 days in the pre-intervention group ($P = 0.04$). There were no statistically significant differences for the other secondary outcomes, including the score on the Experience of Treatment in ICU 7 item questionnaire, number of tracheostomies and number of self-extubations. Records of compliance to recording the sedation score during both phases revealed that patients were slightly more deeply sedated when the guideline was used. *Conclusions:* The use of the algorithm-based sedation guideline did not reduce duration of mechanical ventilation in the setting of this study.

Keywords Intensive care · Mechanical ventilation · Clinical practice guideline · Sedation · Nursing

Introduction

Opioid and sedative medications are often administered to intensive care patients to provide pain relief and reduce anxiety. Patients who receive inadequate pain relief or anxiolysis are at risk of agitation, injury and psychological distress [1, 2]. The effects of providing too much of these medications are as serious although less obvious, for example prolonged sedation may lead to the avoidable prolongation of mechanical ventilation and concomitant complications of ventilation and reduced mobility [3, 4, 5].

A potential solution to these difficulties is a clinical practice guideline (CPG) incorporating a target sedation level. Several studies have revealed clinically and statistically significantly positive patient outcomes associated with the use of sedation guidelines [3, 4, 5, 6, 7, 8, 9, 10, 11]. For example, a randomised controlled study performed in a North American intensive care unit (ICU) examined the effect of a nurse-initiated algorithm-based protocol (a CPG) [8]. The algorithm stipulated a target sedation level based on an assessment using the Ramsay Scale (Ramsay score 3) [12] and the

type of opioid and sedative medication [8]. Benefits that were identified included reduced duration of ventilation, shorter ICU length of stay and fewer tracheostomies.

To date no studies of sedation CPGs have been reported in the Australian context. Therefore we performed a prospective quasi-experimental pre-intervention and post-intervention investigation to examine the effect of a sedation guideline that had previously been developed and shown to be beneficial in a North American ICU [8]. The main objective was to test whether the use of the algorithm-based sedation guideline would decrease the duration of mechanical ventilation compared with conventional non-guideline-directed baseline sedation delivery practices. Therefore the primary outcome measure was the duration of ventilation. The secondary aim of the study was to investigate whether there was any difference in the experience of recovery after intensive care between the pre-intervention and post-intervention groups. Other secondary outcomes included ICU length of stay, number of tracheostomies and number of unscheduled self-extubations.

Materials and methods

Design and setting

This pre-intervention, post-intervention comparative investigation was conducted in a 14-bed adult general ICU at a metropolitan 600-bed hospital in Sydney, Australia. The hospital is a tertiary referral centre for several specialities, including burn injury, spinal cord injury, renal disease and cardiology.

The ICU is classified as 'a closed unit': patient treatment is overseen by the intensive care staff specialist. Each of the eight intensive care specialist medical officers is allocated to the unit for 7 days in rotation. The intensive care specialist and intensive care fellow are on site for 12 h of the day and are on call by pager or telephone at all other times. The resident medical officers are in 24-h attendance. Registered nurses perform all the nursing care for ICU patients. The registered nurse to patient ratio is 1:1 for mechanically ventilated patients with the additional clinical support of a Clinical Nurse Educator, Nurse Unit Manager and Clinical Nurse Consultant in the daytime from Monday to Friday.

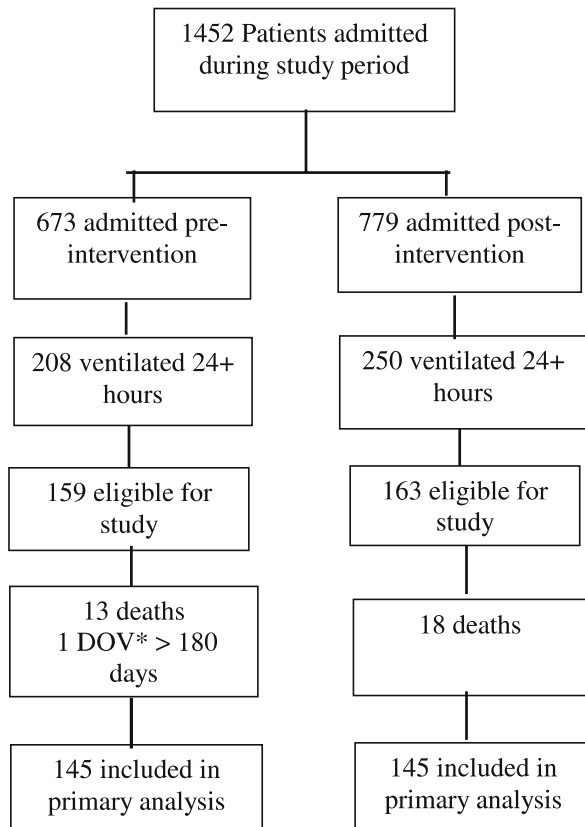
Other practices related to mechanical ventilation and weaning directed by individual staff specialists, such as the insertion of tracheostomies, weaning from mechanical ventilation and extubation, did not change during the study. For example, it is usual practice to consider patients for percutaneous tracheostomy when they have been intubated for more than 7 days. There was no explicit sedation algorithm used in the study ICU prior to the introduction of the sedation guideline developed and found to be beneficial in the study by Brook et al. [8].

The study period was from November 2002 to December 2004. It started with a 10-month pre-intervention data collection phase. A post-intervention phase of 12 months followed the implementation of the sedation guideline previously developed for use in the Brook study [8].

Participants

Sample size estimates for this project were based on the findings of previously published research [8]. The study ICU was a general adult ICU similar to that in the Brook study, with similar patient characteristics. A mean difference between groups was detected in duration of ventilation of 35 h (1.45 days, $P = 0.003$) in the Brook study [8]. The required sample size per group was calculated to be 142, to which we added 10% to allow for deaths in ICU. Therefore we aimed to include 160 patients in each group, with 80% power to detect a mean difference in the duration of mechanical ventilation between groups of 1.4 days. Statistical significance was defined as a P value less than 0.05.

Participants were selected consecutively until the required sample size per group was reached. Details of the number of patients admitted and included in the study and included in the analysis of the primary outcome are provided in Fig. 1. Research participants were selected if they were mechanically ventilated while they were in intensive care. Patient eligibility criteria were selected to achieve a general sample of intensive care patients. Participants were eligible for inclusion if they were adults older than 17 years. Patients were excluded if the goal of administering analgesic and sedative medications was to provide anaesthesia or palliative care. For example, a patient with a primary diagnosis of traumatic head injury when intracranial pressure control was the priority was excluded, as was a patient who was not expected to live for more than 24 h after admission and a decision 'not to escalate treatment'. Patients were excluded if admitted post-operatively with planned early discontinuation of ventilation. Patients with neuromuscular diseases such as Guillain-Barré syndrome were excluded as they were likely to be ventilated for more than 21 days. Alternative sedative and analgesic regimens were provided for patients with severe burn injury; therefore they were also excluded. Patients with high spinal cord injuries (above vertebra C5) were excluded as many such patients may be reliant on mechanical ventilation beyond the ICU stay. Patients were also excluded if they had previously been enrolled in the study. Each day the study unit was screened for eligible patients, resulting in capture of data from all eligible patients. Ethics approval was granted by the human research ethics committees of the hospital and of the University of Technology, Sydney.



* DOV – Duration of ventilation

Fig. 1 Flow chart showing numbers of patients included in analysis of length of ventilation

Intervention: sedation guideline

The algorithm-based sedation guideline used in this study was intended to be a replication of a sedation guideline which was previously shown to be beneficial [8]. However, due to the lack of availability of intravenous lorazepam in Australia, midazolam was used (Fig. 2). The guideline involves an initial assessment of the need for sedation on the basis of a target Ramsay score of 3, and there is a prompt to assess the need for analgesia. Alternative regimens for sedation and/or analgesia are suggested. The use of an intravenous opioid for analgesia and an intravenous benzodiazepine medication for reducing the effect of stressors and sources of discomfort was usual practice before the guideline was implemented. The intervention is a standardised version of the sedation practices which were commonly used for mechanically ventilated patients before the guideline was implemented with the addition of an explicit target sedation level. In accordance with Australian legal requirements a medical officer prescribed all medications in the algorithm-based sedation guideline before administration by the registered nurse. The route and equipment used

for administering the medications were the same for both phases.

Study procedures

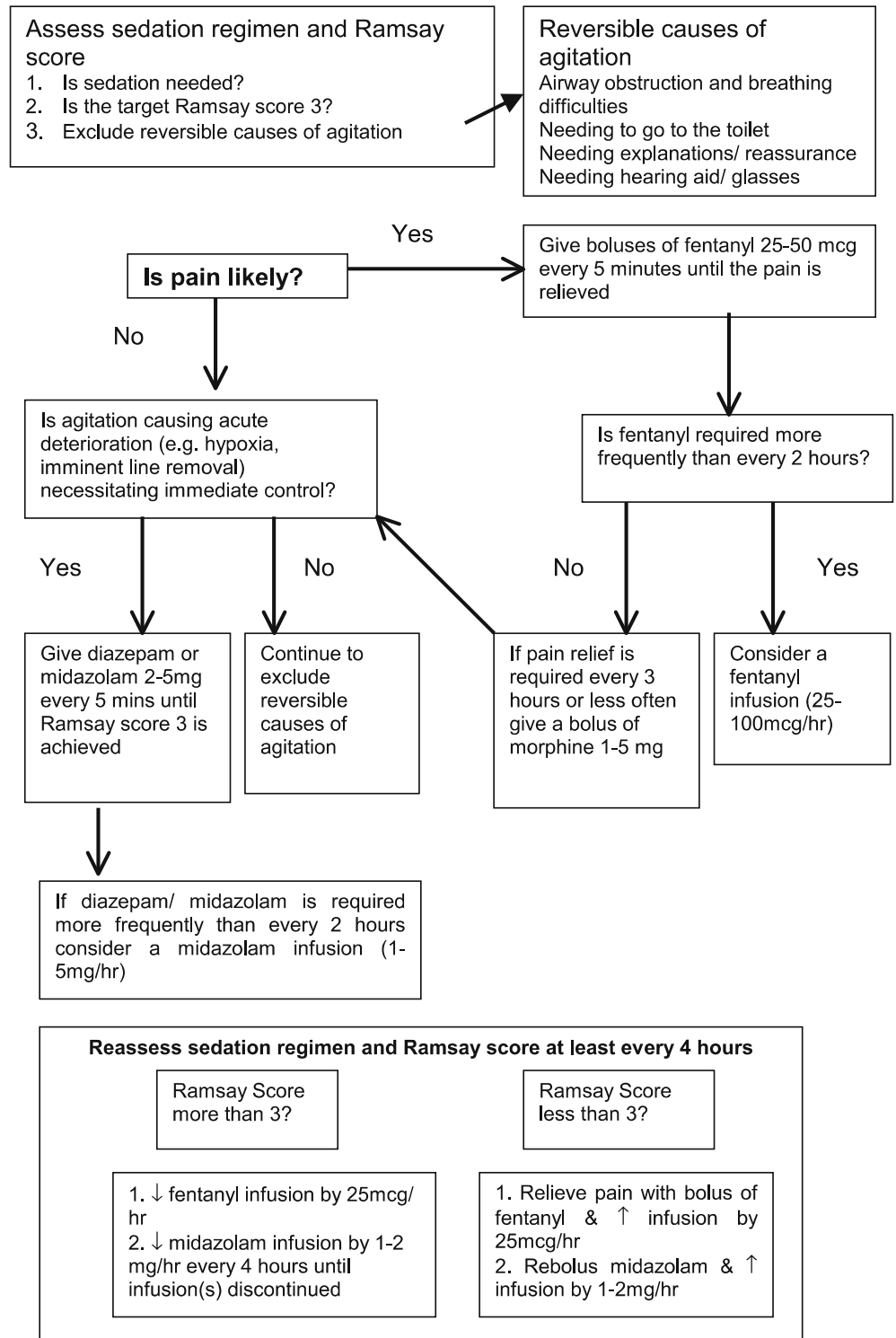
Eighteen months prior to the introduction of the intervention and 10 months before data collection in the pre-intervention phase began, the Ramsay Scale [12] was introduced to the study ICU. In order to minimise the impact on existing sedation delivery practices the bedside nurses were simply requested to document the Ramsay score and not change their existing sedation delivery practices. No changes in ventilation practices were made.

During the pre-intervention phase the main outcome data were collected from 159 patients while they were cared for in ICU. The demographic data, that is age, gender, diagnosis and Acute Physiology and Chronic Health Evaluation II (APACHE II) score [13], and primary outcome data concerning the duration of mechanical ventilation were collected for all eligible patients while they were in ICU. Secondary outcomes, that is length of ICU stay, number of tracheostomies, number of reintubations and unscheduled extubations, were also collected. During the same period rates of compliance in the use of the Ramsay Scale were collected from all patients in the ICU on a random day of the month. Adherence to recording the sedation score using the Ramsay Scale was operationalised as ‘Is the Ramsay score documented every four hours during daylight hours?’ The process and results are reported more extensively elsewhere [14].

Prior to the introduction of the sedation guideline opioid medications were routinely administered to provide analgesia and benzodiazepines and propofol were routinely administered for sedation. The sedation guideline was introduced using a multifaceted implementation strategy over a 2-month period between the pre-intervention and post-intervention phases. The strategy included intensive one-to-one information sessions for 80% of bedside clinicians, formal presentations, placement of humorous reminders in prominent positions, regular feedback on rates of the use of the guideline in the ICU newsletter, placement of the guideline and Ramsay Scale at the bedside and daily reminders. These strategies continued throughout the post-intervention phase. During the post-intervention phase data were collected from a further 163 patients as described for the pre-intervention phase. Compliance to the guideline, operationalised as documentation of the Ramsay Scale during daylight hours and the use of the medications suggested in the guideline if appropriate, was audited on all patients in the ICU on random days.

The Experience after Treatment in Intensive Care 7 Item Scale (ETIC-7) [15] data was used to measure any effect of the change in sedation delivery practices on the patient’s perspective of recovery. The ETIC-7 data

Fig. 2 The Royal North Shore Hospital ICU sedation algorithm



were collected when the patient had returned home. The ETIC-7 contains seven items based on the criteria for post-traumatic stress disorder (PTSD) [16]. There are four possible responses to each ETIC-7 item on a Likert

scale from 'Not at all' (score of 0) to 'Often' (score of 3). Possible total scores thus range from 0 (no signs of PTSD) to 21 (high likelihood of PTSD). There is an open-ended question 'Would you like to add any comments?' after

the seven items. The ETIC-7 has previously been validated and correlated well with both the Hospital Anxiety and Depression Scale [17] and the Impact of Events Scale [18]. The internal consistency reliability for the ETIC-7 was reported to be high [15]; in the present study Cronbach's α was 0.81. Patients who could be contacted by telephone were interviewed about their perspective of recovery after treatment in ICU in the pre-intervention and post-intervention phases.

Statistical analysis

Data were transferred to Excel (Microsoft, CA, USA) for management purposes. SPSS version 13 (SPSS Inc, IL, USA) and StatXact version 4.0 (Cytel, MA, USA) were used to perform the statistical analyses.

Continuous variables were analysed using the bi-directional Kolmogorov–Smirnov statistic to examine the assumption that the probability distributions for the pre-intervention and post-intervention groups were similar. If they were similar ($P > 0.05$) then the Wilcoxon–Mann–Whitney U-test was used to examine the difference in location between them. Monte Carlo randomisation methods were used because the pre-intervention and post-intervention groups were not random independent samples. Monte Carlo probabilities, based on 10,000 random samples, are reported together with their 99% confidence intervals (CI).

The comparison of the pre-intervention and post-intervention groups with respect to binary variables were analysed using Fisher's exact test on the frequency tables. The distribution of diagnostic codes for the pre-intervention and post-intervention were compared using likelihood ratio chi-square test and Monte Carlo randomisation methods.

The number of self-extubations and reintubations were not subjected to inferential statistical testing because there were so few. Therefore the number of self-extubations and reintubations and compliance data are described.

All deaths ($n = 70$) were excluded from the analysis of length of stay and deaths prior to cessation of ventilation ($n = 31$) were excluded from duration of ventilation. One extreme outlier whose total time on ventilation was greater than 180 days (or 6 months) was also excluded from these analyses. The Mann–Whitney U-test was used to compare the groups because neither variables involve censoring. The Kaplan–Meier method was used to describe the cumulative distribution function of duration on ventilation. The effect of the APACHE II scores on duration of ventilation was examined using scatter plots with fitted ordinary least squares regression lines for each of the groups. Pearson's correlation coefficient was used to detect a significant positive effect on duration of ventilation and Monte Carlo methods were used to obtain P values.

Results

Patient characteristics

Data from a total of 322 consecutive patients ($n = 159$ pre-intervention; $n = 163$ post-intervention) were collected in this study. Seventy patients died during care in ICU, of whom 31 died prior to cessation of ventilation. The groups were similar for all characteristics except the number of patients with neurological diagnoses (Tables 1 and 2). When diagnostic groups were compared with the patients with neurological diagnoses removed there was no difference between the groups ($P = 0.73$). There were no significant differences between groups for age and APACHE II score. There were nine patients with neurological diagnoses in the pre-intervention group but none in the post-intervention group, which was significant ($P < 0.002$) (Table 2). However, their characteristics, including duration of ventilation and length of stay, were random.

Duration of mechanical ventilation

A total of 290 patients were included in the analysis of duration of ventilation, as shown in Fig. 1. There were 145 patients in the pre-intervention group and 145 in the post-intervention group. The median duration of ventilation was longer for the post-intervention group: 5.6 days [interquartile range (IQR) 2.9–10.9] compared with 4.8 days (IQR 2.1–9.2) for the pre-intervention group ($P > 0.05$) (Table 3). Kaplan–Meier plots of the probability of successful weaning from the ventilator are shown in Fig. 3. There was a weak but significant positive correlation between severity of illness (APACHE II score) and duration of ventilation (pre-intervention $R^2 = 0.034$, $n = 145$ and post-intervention $R^2 = 0.059$, $n = 145$).

The ETIC-7 score

Three attempts were made to reach the former ICU patients by telephone when they returned home, resulting in 36.6% ($n = 118$) of the sample responding to the ETIC-7. Patients were contacted according to usual practice in the study ICU between 1 month and 6 months after discharge from ICU and within 3 months, with a usual elapsed time of 3 months since ICU discharge. Refusals were rare (two per group). The number of males, duration of mechanical ventilation, length of ICU stay, age, APACHE II score, number of post-operative patients and number of tracheostomies for the group who responded were compared with those for the group who did not ($n = 204$). There were no statistically or clinically significant differences between the two groups for any of the characteristics. The median ETIC-7 score for the pre-intervention group was 1 (IQR 0–4) and

Table 1 Group characteristics

Characteristic	Pre-intervention (n = 159)	Post-intervention (n = 163)	P (Monte Carlo 99% CI)
Males, number (%)	93 (58.5)	94 (57.7)	0.91 ^a
Age in years, median (IQR)	63.6 (45.5–75.2)	66.1 (51.5–75.1)	0.51 (0.49–0.52) ^b
Operative, n (%)	29 (18.2)	32 (19.6)	0.78 ^a
Mechanical ventilation started prior to admission to study ICU, n (%)	114 (71.7)	111 (68.1)	0.54 ^a
APACHE II, median score (IQR)	21 (17–26)	22 (17–27)	0.72 (0.71–0.73) ^b
Deaths, n (%)	30 (18.9)	40 (24.5)	0.23 ^a

^a Fisher's exact test, ^b Monte Carlo Mann – Whitney U-test (IQR, Interquartile range; APACHE, Acute Physiology and Chronic Health Evaluation)

Table 2 APACHE III diagnostic code group comparisons, n (%)

Characteristic	Pre-intervention (n = 159)	Post-intervention (n = 163)	P
Respiratory	33 (21)	45 (28)	0.002 ^a
Cardiac	35 (22)	42 (26)	
Gastrointestinal	21 (13)	21 (13)	
Neurological	9 (6)	0 (0)	
Sepsis	34 (21)	31 (19)	
Trauma	14 (9)	15 (9)	
Other	13 (8)	9 (5)	

^a Fisher's exact test

0 (IQR 0–3) for the post-intervention group ($P = 0.529$, Monte Carlo 99% CI 0.516–0.542) (Table 3).

Twenty-five out of 60 patients in the pre-intervention group and 14 out of 58 patients in the post-intervention group responded specifically to the open-ended question on the ETIC-7 tool 'Would you like to add any other comments?'. Data were examined using content analysis (Table 4). In summary, many spontaneously commented on their inability to remember ICU and several patients who had unreal memories commented with bemused acceptance. Some patients who had higher ETIC-7 scores recounted more bothersome memories than patients who did not comment.

Length of stay in ICU

A total of 251 patients were included in the analysis of length of stay (31 died before ventilation was ceased, 39 patients died after mechanical ventilation was ceased, and there was one outlier). The pre-intervention group contained 128 and the post-intervention group 123 patients. There was a longer length of stay in the post-intervention group: 8.16 (IQR 4.92–15.62) days versus 7.06 (IQR 4.14–11.18) days in the pre-intervention group ($P = 0.04$, Monte Carlo 99% CI 0.037–0.048) (Table 3, Fig. 4).

Number of tracheostomies

Although there was a trend towards a greater number of tracheostomies in the post-intervention (30 versus 21 in the pre-intervention phase) this was not statistically significant ($P = 0.22$) (Table 3).

Compliance to recording the sedation score and sedation guideline

Perfect compliance to recording the Ramsay score (i.e. recording the score at least each 4 h during daylight hours) was 13% in the pre-intervention phase but improved to

Table 3 The effect of the sedation CPG on the clinical measures including duration of mechanical ventilation

Outcome	Pre-intervention (n = 159)	Post-intervention (n = 163)	P (Monte Carlo 99% CI)
Duration of mechanical ventilation, median days (n, IQR) ^a	4.8 (145, 2.1–9.2)	5.6 (145, 2.9–10.9)	0.99 ^b
ETIC-7 score, median (n, IQR)	1 (60, 0–4)	0 (58, 0–3)	0.53 (0.52–0.54) ^b
Length of ICU stay, median days (n, IQR)	7.06 (128, 4.14–11.18)	8.16 (123, 4.92–15.62)	0.04 (0.037–0.048) ^b
Tracheostomy, n (%)	21 (13.2)	30 (18.4)	0.22 ^b
Reintubations, n (%)	7 (4.4)	6 (3.6)	
Self-extubations, n (%)	2 (1.3)	2 (1.2)	

^a Uni-directional hypothesis, ^b Monte Carlo Mann – Whitney U-test (ETIC-7, Experience after Treatment in ICU-7)

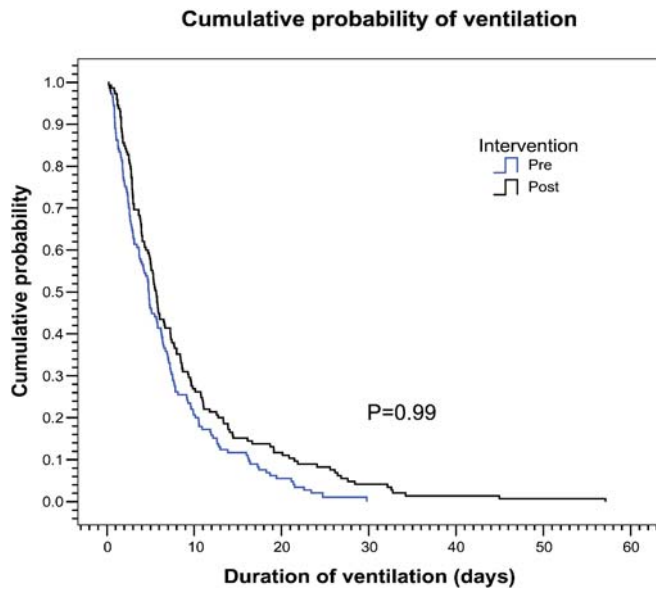


Fig. 3 Kaplan –Meier cumulative probability curves of duration of ventilation for each group

50% in the post-intervention phase. The most frequently recorded Ramsay score (that is the mode) was 2 during the pre-intervention phase, 40% of all scores recorded, and 3 during the post-intervention phase, 31% of all scores recorded. In contrast, 12% of recordings in the pre-intervention phase were 3, and 28% of recordings in the post-intervention phase were 2. Only 5% of recorded scores were 1 (i.e. anxious and/or agitated).

During the audits of guideline compliance on all current ICU patients’ charts on random days in the post-intervention period, 59% of patients were ineligible for

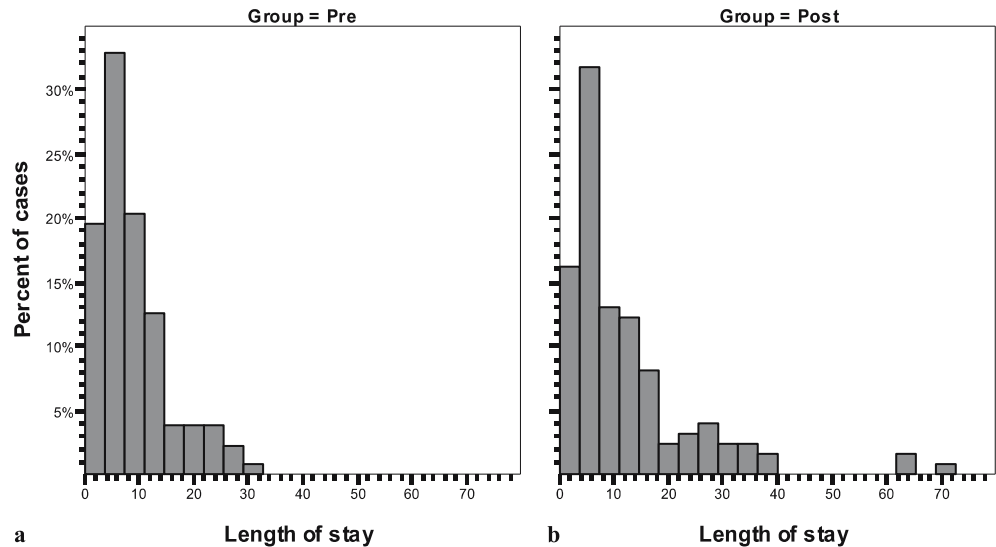
Table 4 Content analysis for the open-ended question, ‘Would you like to add any comments?’ (ETIC-7)

Content	Pre-intervention (n = 25)	Post-intervention (n = 14)
Bad images and blamed medication*	3	0
Cannot remember ICU	5	4
Deluded and bemused	7	2
Bad images and bothered*	4	5
Reassuring images	3	1
Spiritual memories	0	1
Feel lonely at home now	2	0
Guilt for what the family went through	0	1
Distressed by hospital	1	0

*Included paranoid thoughts and perceptions of persecution

the guideline, for example patients no longer mechanically ventilated and post-operative cardiac patients. Of the other 41% of the patients on audit days, perfect compliance with the sedation guideline (i.e. no deviation from documenting the Ramsay score during daylight hours and using the medications suggested in the guideline) was 18%. The rate of non-compliance with the guideline in suitable patients based on appropriate clinical judgement (i.e. deviation from guideline according to clinical judgement about the patient’s condition, for example the use of propofol instead of midazolam for patients with acute renal failure) was 13%. Non-compliance with the guideline with no obvious rationale was found in 10% of audits. Compliance data are extensively reported and discussed elsewhere [14].

Fig. 4 Histograms of length of stay: **a** pre-intervention; **b** post-intervention



Discussion

Our study revealed that the use of the algorithm-based sedation guideline did not reduce duration of mechanical ventilation in the ICU of the study. There was a trend towards a longer duration of ventilation in the post-intervention group, the group who received the sedation guideline. There was no difference between groups for the measure of the change in the patient's perspective of recovery after intensive care, that is ETIC-7 score. However, the increase in ICU length of stay of approximately 1 day in the post-intervention group was statistically significant. There were no other differences in the secondary outcomes that were measured.

The clinical significance of these results must be carefully considered. The median increase in duration of ventilation of 0.8 days found in this study contrasts with the results reported in studies from other countries. Significant decreases in the duration of ventilation have been reported previously as a result of the use of sedation guidelines [1, 3, 5, 7, 8, 9]. In particular, patients who received sedation using the algorithm in the Brook study had a significantly shorter duration of ventilation, although sedation level data were not reported in that study [8]. Therefore, it is not known whether the patients in the control group of that study were sedated more deeply than the level of 3 specified in the guideline. The trend in our results is consistent with the findings of the only other study of sedation guidelines which has reported sedation levels [19]. Duration of mechanical ventilation was 205.8 h in the protocol-directed group and 162.5 h in the control group in a pre/post design study performed in Canada [19]. Though the difference was not statistically significant, the direction of this result was not expected by the authors, and was attributed by the authors to deeper sedation levels and the reduction in the number of patients who were anxious or agitated (i.e. Ramsay score 1) from 22% to 11%. When we commenced auditing of sedation scores in the pre-intervention phase we found that the frequency of Ramsay scores of 1 in our study was very low, and the longer duration of ventilation is therefore unlikely to be due to better sedation of anxious and/or agitated patients. Patients appear to have been slightly more deeply sedated in the post-intervention phase, in accordance with the guideline but in contrast to the previously unknown sedation score of 2, which may have contributed to the observed increase in length of ICU stay. The baseline characteristics of the patients in both phases were similar, except that there were no patients with a neurological diagnosis in the post-intervention phase (versus 6% pre-intervention), which may have had some unmeasured effect, but slightly deeper sedation (cooperative, orientated and tranquil versus responsive to command) may have contributed to the greater length of stay during use of the guideline.

The duration of mechanical ventilation for eligible patients in the pre-intervention phase in this study was shorter

than the baseline duration of ventilation reported in some published studies that have shown a reduction in the length of ventilation with the use of a guideline. For example the baseline median duration of ventilation was 10.3 days in the study by DeJonghe et al. [7], and a mean of 7.4 days was reported by Brattebø and colleagues [9]. Thus there was more scope for reduction of ventilation times. Similarly, although the reduction in duration of ventilation by a day and a half in the Brook et al. study [8] is clinically significant, the sedation guideline that was effective in that context was designed for use where nurse-to-patient ratios are lower than in many Australian ICUs (T Ahrens, personal communication, 22 February 2003).

In summary, the failure to reduce the duration of mechanical ventilation in the present study was probably due to the satisfactory baseline practice of sedation delivery in the study unit, that is the achievement of the optimal sedation level of a co-operative, orientated and tranquil patient. This presents an important message to clinicians who work in ICUs where sedation levels already reflect current best practice. Attempts to reduce duration of ventilation by implementing a sedation guideline may not be successful. Although compliance with the sedation guideline was low in the early stages, it did increase through the intervention period in our study; hence, this does not explain the failure to reduce duration of mechanical ventilation.

Our study has a number of limitations. The study was performed using a guideline developed for use in another health care context. The guideline was adopted for use in our study with little alteration for the local context, that is the replacement of intravenous lorazepam with midazolam. The pre-intervention and post-intervention design was a strength and a limitation. The design decreased the possibility of the introduced guideline affecting concurrent normal practice in patient sedation, that is, contamination of sedation practices in the control group. However, the resulting lack of randomisation of patients to the two modes of practice precluded the use of more powerful statistical methods designed for random and independent samples, warranting caution in the interpretation of the increase in length of stay. We did not prospectively measure all clinically important influences on duration of ventilation, such as cause of respiratory failure. Limited data were collected on the amount of sedative agents and opioid medications administered to patients and are not reported here. The possible relationship between changes in sedation delivery practices and clinical outcomes has been examined previously. It has been reported that the use of continuous sedation increases duration of ventilation [4].

Attempts were made in this study to examine the rates of compliance with both the sedation scoring system and the guideline in total. The compliance rate with the guideline was satisfactory; among patients who were eligible for use of the guideline, compliance was perfect or in a form appropriately modified for individual patients in the vast

majority of cases, with a very low rate of non-compliance for no apparent reason. Compliance was assessed by auditing the charts of all patients in the ICU on random days and noting the frequency of recording the sedation score and use of the guideline. While collection of actual, objective compliance data in this way is superior to reliance on self-reported use of guidelines by the targeted clinicians, as reported by some authors [14], the data permit limited conclusions. A preferable approach would be to attempt to capture compliance on every patient eligible for the guideline, but this is costly and laborious in the absence of automated clinical information systems.

In conclusion, the findings of this study contribute to the understanding of the effect of a sedation guideline in intensive care patients cared for in an Australian ICU. The findings suggest that clinical practice guidelines developed and measured in other health-care settings may require examination in the context of the local health-care setting before implementation. The multifaceted implementation strategy used to introduce both the Ramsay sedation scale and the sedation guideline was highly effective in achieving clinicians' co-operation, but was not associated with a reduction in the duration of mechanical ventilation in this setting.

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