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Research paper

Weight and height documentation: Does ICU measure up?

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ABSTRACT

Background: Reliable assessment and documentation of weight and height are essential for the accurate delivery of many critical care interventions.

Methods: We conducted a 3-month retrospective, cross-sectional, single-centre audit to determine the prevalence of weight and height documentation in the clinical records of patients admitted to the intensive care unit (ICU) for the period from 3 months prior to hospital admission up to hospital discharge.

Results: One hundred forty-one index ICU admissions were identified from October–December 2015 with 138 medical records available for analysis. Median (interquartile range) age was 64.5 (50.8–75.3) years, the majority were male (60.9%, 84/138), and the ICU admission Acute Physiology and Chronic Health Evaluation II score was 19.0 (14.0–25.0). Overall, weight and height were recorded in 90 (65.2%) and 63 (45.6%) patients, respectively. For elective postoperative admissions ($n = 20$), weight and height were recorded in 20 (100%) and 19 (95%) patients. For emergency medical and surgical admissions, 70 (59.3%) and 44 (37.2%) patients had weight and height recorded in both the 3-month period prior to hospital admission and the in-hospital period. A moderate, positive correlation was shown, $r = 0.55$, $P < 0.001$, with a longer hospital length of stay being associated with a greater number of weight and height records for each patient. In the emergency patient cohort, 81.7% ($n = 215/263$) of weight- and/or height-based interventions occurred before or during the ICU admission, of which 69.9% ($n = 184/263$) required consideration of ideal body weight.

Conclusion: Measurement and medical record documentation of weight and height is infrequently performed in ICU patients. Given the clinical requirement for accurate measurement and documentation, further research to understand the barriers to perform and document this important process of care is necessary.

1. Introduction

Healthcare standards recommend that healthcare providers use accurate weight and height measurement for many patient interventions including identification of nutritional risk,[1] safe prescribing practices,[2–5] manual handling,[6] and skin integrity management.[7] However, measurement and documentation in the hospital medical record is variably performed, with rates reported to vary between 22% and 50%.[2,8,9] In the intensive care environment, the delivery of invasive mechanical ventilation,[10–12] supplemental nutrition,[13,14] haemodynamic assessment,[15] and dosing of narrow therapeutic-index medications,[16–18] all require reliable measures of height and weight (ideal and actual). However, information pertaining to the documentation of these vital measurements in the critically ill is limited.

The primary aim of this audit was to determine the prevalence of weight and height documentation in the medical records of patients admitted to the intensive care unit (ICU). The secondary

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aim was to explore factors that may influence the recording of such measurements.

2. Materials and methods

2.1. Study population and design

A 3-month single centre, retrospective, cross-sectional audit was conducted in a tertiary-referral, university-affiliated hospital. All patients admitted to the mixed medical-surgical ICU between the period October 1, 2015 and December 31, 2015 were included. Approval to conduct the audit was obtained from the institutional Ethics of Human Research Committee and requirement for consent was waived.

2.2. Data collection

Patient medical records for the relevant index hospital admission were reviewed, and data were collected for the period from 3 months prior to the index hospital admission until hospital discharge. Data included (i) patient demographics (age, gender); (ii) ICU admission diagnosis, category (elective or emergency post-operative, medical) and Acute Physiology and Chronic Health Evaluation II (APACHE II) score; (iii) the number of weight- and height-sensitive therapies or medications administered (invasive mechanical ventilation, intravenous or therapeutic low molecular weight heparin, and vancomycin and gentamicin administration); (iv) presence of weight and height documentation, including the type of healthcare professional responsible for documentation and the location of notation within the medical records; (v) general ward, ICU and hospital length of stay; and (vi) hospital discharge status.

Table 1
Patient characteristics (n = 138).

Characteristic	
Age, years	64.5 (50.8, 75.3)
Gender (male), n (%)	84 (60.9)
APACHE II score	19 (14.0, 25.0)
ICU admission category, n (%)	
Elective surgical	20 (14.5)
Emergency surgical	28 (20.3)
Medical	90 (65.2)
Reason for ICU admission, n (%)	
Gastrointestinal, surgical	34 (24.8)
Metabolic	27 (19.7)
Respiratory	25 (18.2)
Cardiovascular	16 (11.7)
Gastrointestinal, medical	11 (8.0)
Sepsis	7 (5.1)
Musculoskeletal	6 (4.4)
Genitourinary	5 (3.6)
Neurological	3 (2.2)
Other	3 (2.2)
Intervention, n (%)	
Invasive mechanical ventilation	59 (42.8)
Vasoactive support	33 (23.9)
Renal replacement therapy	7 (5.1)
Length of stay, days	
ICU	1.9 (1.0, 5.2)
Hospital	9.1 (4.9, 18.8)
Mortality, n (%)	
ICU	12 (8.6)
Hospital	22 (15.8)

APACHE = Acute Physiology and Chronic Health Evaluation; ICU = intensive care unit.
Data presented as median and 25th, 75th interquartile range unless otherwise stated.

2.3. Statistical analysis

Weight and height were treated as continuous variables, and the presence of medical record documentation was divided into four time periods; 3 months prior to the index hospital admission, in-patient period prior to ICU admission, ICU admission, and in-patient post-ICU to hospital discharge). Data are reported as either proportion, median (25th, 75th interquartile range) or mean (standard deviation) depending upon distribution. Tests of normality were calculated using the Shapiro–Wilk test for normality. Depending upon distribution, variance was performed using either the independent sample *t* test or Mann–Whitney U test. Chi-square test of significance was reported using Yates Continuity Correction or Fisher's Exact Probability. The Spearman rank-order correlation coefficient was used to assess the level of association between non-parametric continuous variables. Analysis was performed using IBM SPSS Statistics for Mac, version 23.0.0, (IBM Corp, Armonk, NY, USA). A P value of less than 0.05 was considered statistically significant.

3. Results

During the 3-month audit period, there were 141 index ICU admissions. Medical records were missing for three patients, leaving a total of 138 medical records for analysis. The median (interquartile range) age was 64.5 (50.8–75.3) years, the majority were male (60.9%, 84/138), and the APACHE II score was 19.0 (14.0–25.0) (Table 1). Weight and height was documented in the medical records in 90 (65.2%) and 63 (45.6%) patients, respectively, for the 3-month period prior to ICU admission and up to hospital discharge. Documentation was recorded in nine of a possible 16 different locations within the medical records; the most common being nursing weight charts (n = 239/513, 46.1%), dietician progress note entries (n = 118/513, 22.8%), anaesthetic operative records (n = 56/513, 10.8%), and nursing day of surgery assessments (45/513, 8.7%) (Table 2).

Of the 138 patients, a total of 518 weight and height measurements were recorded. Weight documentation (n = 411/518, 79.3%) was four times more common than height documentation (n = 107/518, 20.7%); equating to 5.3 and 1.2 measurements per patient, respectively, who had a measurement performed. Nursing staff recorded the most measurements (65.9%, n = 342/518), followed by medical staff (n = 114/518, 22.1%), dieticians (n = 58/518, 11.3%), and pharmacists (n = 4/518, 0.7%).

Documentation was most common in elective postoperative admissions with weight recorded in 100% of patients (n = 20/20) and height in 95.0% (n = 19/20), either in the 3-month period prior to hospital admission or on the day of scheduled surgery. For the remaining 118 emergency surgical and medical admissions, weight was documented in 70 (59.3%) patients, and height was documented in 44 (37.2%) patients; $P < 0.001$ for both versus elective surgery patients. Of the two groups, those patients who had a weight recorded were older, had a primary surgical gastrointestinal diagnosis, and had been an inpatient prior to ICU admission ($P < 0.05$). Hospital length of stay displayed a moderate, positive correlation, $r = 0.55$, $P < 0.001$, with a longer hospital length of stay being associated with a greater number of height and weight records for each patient (see Fig. 1). There were no significant differences between patients who had a measurement recorded, and those patients who had no measurement recorded in the number of patients receiving mechanical ventilation and renal replacement therapy in the first 24 h of ICU admission.

The prevalence of weight and height documentation in emergency surgical and medical admissions was 59.3% (n = 70/118) and 37.2% (n = 44/118), respectively. The rate of documentation was

Table 2
Presence or absence of weight and height documentation for medical and emergency surgical patients.

Characteristic	Recorded (n = 70)	Non-recorded (n = 48)	P value
Age, years	66.5 (55.1, 77.2)	57.2 (44.0, 71.9)	0.01
Sex (male), n (%)	40 (57.1)	32 (66.7)	0.43
APACHE II score	21.0 (16.0, 28.0)	17.0 (13.0, 27.0)	0.51
Surgical, n (%)	25 (35.7)	4 (8.3)	<0.001
Medical, n (%)	45 (64.2)	44 (91.7)	<0.001
Reason for ICU admission, n (%)			
Metabolic	8 (11.4)	18 (40.9)	<0.001
Respiratory	13 (18.6)	9 (20.5)	0.82
Cardiovascular	10 (14.3)	6 (13.6)	0.99
Gastrointestinal, surgical	20 (28.6)	3 (6.8)	0.003
Gastrointestinal, medical	7 (10.0)	6 (13.6)	0.86
Musculoskeletal	4 (5.7)	1 (2.3)	0.40
Sepsis	5 (7.1)	0 (0)	0.07
Neurological	0 (0)	3 (6.8)	0.68
Other	3 (4.3)	3 (6.8)	0.68
ICU admission source, n (%)			
Transfer from other hospital	12 (17.4)	5 (10.4)	0.45
Emergency department	19 (27.5)	33 (68.8)	<0.001
Emergency surgery/PACU	19 (27.5)	5 (10.4)	0.05
Other ICU	1 (1.4)	1 (2.1)	NA
Ward	18 (26.1)	3 (6.3)	0.005
Interventions in first 24 h, n (%)			
Invasive mechanical ventilation	27 (38.6)	22 (45.8)	0.54
Vasoactive support	22 (31.4)	9 (18.7)	0.18
Renal replacement therapy	3 (4.3)	3 (6.3)	0.68
Length of stay, days			
Ward	2.9 (1.2, 8.1)	1.4 (1.0, 3.0)	0.33
ICU	2.6 (1.5, 6.7)	1.5 (0.8, 5.2)	0.08
Hospital	15.2 (8.2, 25.8)	6.0 (1.9, 9.6)	<0.001
Mortality, n (%)			
ICU	6 (8.0)	6 (13.6)	0.54
Hospital	11 (14.6)	9 (12.0)	0.862

APACHE = Acute Physiology and Chronic Health Evaluation; ICU = intensive care unit; PACU = post-anaesthetic care unit.
Data presented as median and 25th, 75th interquartile range unless otherwise stated.

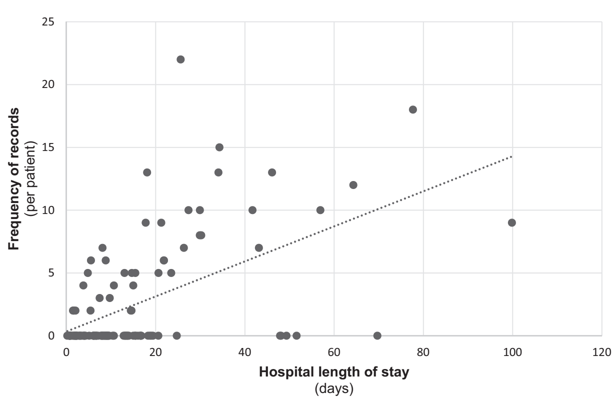

Fig. 1. Relationship between hospital length of stay and the frequency of combined weight and height records for medical and emergency surgical admissions (n = 118).

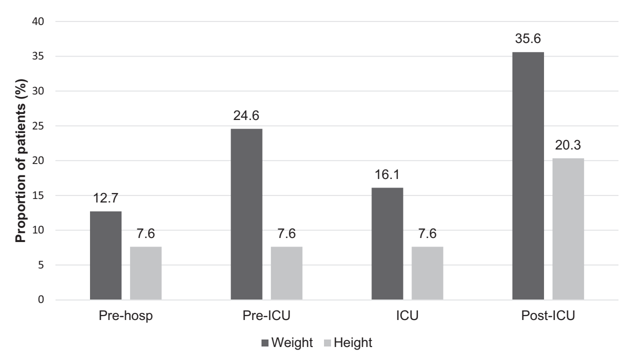

Fig. 2. Hospital location of weight and height measurements for medical and emergency surgical admissions prior to, including and following ICU admission (n = 118). ICU = intensive care unit.

observed to be similar for the time period preceding ICU admission and following ICU discharge; weight 37.2% (n = 44/118) vs 35.5% (n = 42/118), P = 0.49 and height 15.2% (n = 18/118) vs 19.4% (n = 23/118), P = 0.88. In ICU, weight and height were, respectively, assessed in 15.3% (n = 18/118) and 8.5% (n = 10/118) of patients (Fig. 2).

There were 263 weight and height-sensitive therapies administered to those patients included in the audit; these required considerations of either actual body weight 28.2% (n = 79/263), ideal body weight 34.4% (n = 87/263), or height 36.9% (n = 97/263) (Table 3). The majority of interventions occurred in the in-patient period prior to (34.2%; n = 90/263), or during the ICU admission (47.5%; n = 125/263) with the remainder occurring following ICU discharge. Of the interventions that occurred in ICU, approximately one-third, 39.3% (n = 48/122) of patients had the necessary measurement documented on admission to ICU (Table 3).

4. Discussion

Our audit aimed to report the period prevalence of weight and height documentation during a hospital admission that involved a presentation to intensive care. We found that despite their clinical significance; measurements were infrequently documented in both the intensive care and ward environment.

Overall, weight and height were recorded in 90 (65.2%) and 63 (45.6%) patients, respectively. Hurnauth and McDougall studied the practice of 27 intensive and critical care units within 14 National

Table 3
Number and proportion of interventions where ideal and actual body weight and height were recorded on admission to ICU.

Intervention administered	Measurement recorded per intervention n (%)
Actual body weight	
Vancomycin	3/6 (50.0)
Intravenous heparin	4/12 (33.3)
Dexmedetomidine	4/7 (57.1)
Enteral nutrition	9/15 (60.0)
Parenteral nutrition	6/6 (100.0)
Right heart cardiac output	9/9 (100.0)
Ideal body weight	
Gentamicin	4/12 (33.3)
Low molecular weight heparin	2/9 (22.2)
Height	
Invasive mechanical ventilation	7/46 (15.2)

ICU = intensive care unit.

Health Service Trusts; of the 14 trusts, one (7.1%) consistently measured weight and height, with a further four units recording weight and height when performing cardiac output studies.[20] While prevalence is not reported, the results suggest that obtaining accurate height and weight is a low priority within ICU. Within the ward environment, the prevalence of recording has been shown to vary between 24% and 51% of patients.[2,9]

Our analysis has highlighted a greater propensity for actual body weight to be recorded when compared to height, with actual body weight recorded four times (n = 411/518, 79.3%) more frequently than height (n = 107/518, 20.7%). This is despite the use of height to predict ideal body weight. Traditionally, nursing staff are responsible for the measurement of weight and height. This disparity may reflect either a greater significance placed on actual body weight by nursing staff or highlight a lack of understanding of the importance of the addition of height in malnutrition screening or in the prediction of ideal body weight for the prescription of therapies such as mechanical ventilation.

Our audit examined the recording of weight and height across four distinct time periods. Given the retrospective nature of the audit, the methodology used to acquire such measurements was often not recorded. Although estimated weight and height are known to be inaccurate, the urgency and incapacity related to an ICU presentation generally necessitates that estimates of weight are typically used, with height being either estimated or measured by tape measure.[19]

Notwithstanding the importance of malnutrition screening, invasive mechanical ventilation was the most frequently observed intervention, 47.8% (n = 66/138) requiring weight and height measurement. Ideal body weight, as opposed to actual body weight, has been shown to correlate to lung volume and as such is used to guide tidal volume during invasive mechanical ventilation.[21] The use of lung protective ventilation that employs a physiological tidal volume with appropriate levels of positive end-expiratory pressure has been shown to improve clinical outcome, as it serves to decrease the extent and progression of lung injury. Recent trials suggest that among elective surgical patients, critically ill patients with and without adult respiratory distress syndrome, protective mechanical ventilation using a tidal volume of 6–8 mL/kg ideal body weight is associated with better clinical pulmonary outcomes.[22,23] Despite this, there is evidence that only a minority of patients currently receive lung protective ventilation.[24–26] Our audit showed that only a minority of emergency patients (15.2%, n = 18/118) had a height recorded on or during their admission to ICU. This may be due to either the perceived belief that height cannot be accurately measured in recumbent patients[27] or predicted using alternative measurements such as demi-span, ulnar length, or knee height.[28–30]

Little research has examined the factors that limit the measurement of weight and height. The Safety and Quality Unit of the Royal Hobart Hospital studied the attitudes and behaviours of clinicians in obtaining, recording, and utilisation of recorded weight. They reported the barriers to acquiring weight and height measurements to be the lack of access to appropriate equipment (47.1%) and the clinical status of the patient (81.5%).[8,31] While we did not study attitudes or behaviours, our observations differed in that we observed a strong, positive correlation between hospital length of stay and the frequency of weight and height records. The increased number of weight and height records being most likely due to the greater number of opportunities where these measurements were required during an admission, namely for assessment or response to treatment, medication administration, or routine measurement by nursing staff. However, given the proximity to admission, the 3-month period before hospital presentation served as an important contributor of records providing 34.1% and 50.0% of all weight and height measurements utilised upon ICU admission. A barrier to the use of weight and height was the retrieval of measurements within the medical records. Our observations revealed that measurements could be recorded in a total of 16 possible locations. While the most common was nursing weight charts, measurements were additionally recorded in the preoperative day of surgery assessments, anaesthetic, or clinical record. Moreover, despite the role of such measurements in the management of this intensive care cohort, we did not observe any provision for the documentation of ideal body weight. However, despite the absence of a weight or height measurement within the clinical record, it may not mean that either weight or height was not considered.

Our audit relied upon a complete and thorough review of the medical record using a structured approach to detect all potential sources of documentation; this was seen in the number and varying locations of these records.

Our audit has several limitations. First, the method by which weight and height were measured was not documented in the medical record. Despite this, the aim of this audit was to document the overall period prevalence of these measurements as it is these records, regardless of method of measurement, that are ultimately utilised in clinical practice. Second, the reasoning or rationale for weight and height weight measurement was not explored. The decision to perform these measurements is likely to be multifactorial and dependent upon current practice, nursing specialisation, time constraints, and clinical knowledge and/or expectation. The latter may account for the high measurement rate in the outpatient area where patients are independent and cooperative and where staff experience minimal distractions. The clinical triggers within inpatient areas are not as easily elucidated from the medical records. Third, this audit addressed the prevalence of weight and height documentation during a hospital admission requiring an admission to ICU and as such may be difficult to extrapolate these results to the wider in-patient population. Fourth, measurements may have been performed but not recorded. Finally, this audit was performed in an adult in-patient population within one institution and as such may not be representative of paediatric and other adult institutions.

5. Conclusion

Our audit found that the documentation of weight and height during a hospital admission is infrequently performed, in particular for those patients who present to intensive care. Given the frequency of weight and height-sensitive interventions in the critical care setting, the importance of these measurements should not be underestimated by clinicians; albeit the impact of the lack of documentation has upon the delivery of patient care is unclear.

Further research is required to understand the barriers to obtaining and incorporating these measurements into routine patient care and to developing and testing novel prediction models that can be more easily integrated into clinical practice.

Ethical approval

This article reports the findings of a research study that adhered to the National Statement on the Conduct of Human Research by the Australian National Health and Medical Research Council and has been approved by The Queen Elizabeth Hospital Human Research Ethics Committee Approval HREC/16/TQEH/104.

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Author contribution

AM conceived the project, undertook the clinical record review, performed the analysis, and drafted the manuscript. SLP assisted in study design and performed critical revision for intellectual content and manuscript review and in the final revision of the manuscript. PJW assisted in study design, drafting, and in the final revision of the manuscript, and coordinated all aspects of institutional review.

Author agreement statement

All the authors declared that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.

The authors confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. They further confirm that the order of authors listed in the manuscript has been approved by all of them.

They understand that the corresponding author is the sole contact for the Editorial process. He is responsible for communicating with the other authors about progress, submissions of revisions, and final approval of proofs.

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