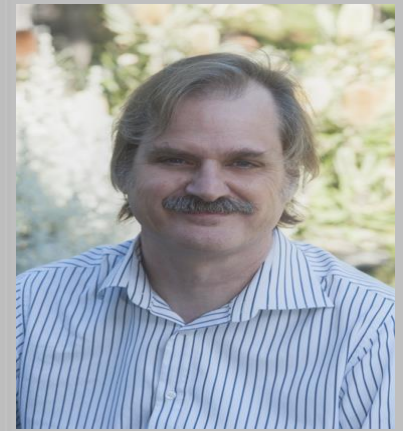


**Davies, H. Leslie, G. Morgan,
D. Dobb, G. A Comparison of
Compliance in the Estimation
of Body Fluid Status using
Daily Fluid Balance Charting
and Body Weight Changes
During Continuous Renal
Replacement Therapy.
Australian Critical Care (2017).
[https://doi.org/10.1016/j.auc
c.2017.12.090](https://doi.org/10.1016/j.auc
c.2017.12.090)**



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43rd
ANZICS/ACCCN
Intensive Care
ASM 11-13
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Adelaide,
South Australia

BACKGROUND

Research paper

A retrospective review of fluid balance control in CRRT

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Gavin D. Leslie PhD, PG Dip (Clin Nurs), BappSc, RN^b
David Morgan FCICM, FACEM, MBBS^c

Australian Critical Care 30 (2017) 314-319

Association between weight change and clinical outcomes in critically ill patients[☆]

Jung-Wan You, MD^a, Seung Jun Lee, MD^b, You Eun Kim, MD^b, Yu Ji Cho, MD^{b,d}, Yi Yeong Jeong, MD^{b,d},
Ho Cheol Kim, MD^{b,d,*}, Jong Deog Lee, MD^{b,d}, Jang Rak Kim, MD^{c,d}, Young Sil Hwang, MD^{b,d}

Journal of Critical Care 28 (2013) 923-927

**Estimation of fluid status changes in critically ill patients:
Fluid balance chart or electronic bed weight?**[☆]

Antoine G. Schneider MD^{a,b}, Ian Baldwin PhD^a, Elke Freitag MN^a,
Neil Glassford MBChB^a, Rinaldo Bellomo MD^{a,b,*}

Journal of Critical Care 27 (2012) 745.e7-745.e12

OBJECTIVES

- (1) Frequency of compliance in weighing patients daily using electronic bed scales
- (2) Evaluation of relationship between calculated fluid balance and body weight changes in patients receiving CRRT

METHODS

- A prospective cohort interventional observation study
- Tertiary ICU between June 2015 & February 2016
- All patients CRRT, >18 years with admission > 24 hours
- Weighed daily & daily fluid balance charted
- Daily differences were compared using Pearson correlation & Bland-Altman analysis
- Insensible Water Losses (IWLs)

RESULTS

	Total	Survivors	Non-survivors	p
No of patients	61	48	13	-
Age, mean (SD), y	56.5 (\pm 18.1)	53.7 (\pm 19.0)	66.8 (\pm 9.2)	0.04
Men, n (%)	43 (70.5)	37 (86.0)	6 (14.0)	-
APACHE-II, mean (SD)	27.2 (\pm 8.4)	26.0 (\pm 8.2)	31.6 (\pm 8.0)	0.05
Admission diagnosis, n (%)	-	-	-	-
Cardiac	13 (21)	10 (21)	3 (23)	-
Gastrointestinal	9 (15)	6 (13)	3 (23)	-
Renal	8 (13)	7 (15)	1 (8)	-
Respiratory	6 (10)	5 (10)	1 (8)	-
Trauma	7 (11)	7 (15)	-	-
Sepsis	11 (18)	7 (15)	4 (31)	-
Other	7 (11)	6 (13)	1 (8)	-
CRRT median (range), d	4 (1-32)	4 (1-32)	7 (2-23)	-
ICU LOS, median (range), d	6 (1-67)	5.5 (1-67)	6.7 (2-22)	-

RESULTS Cont'd

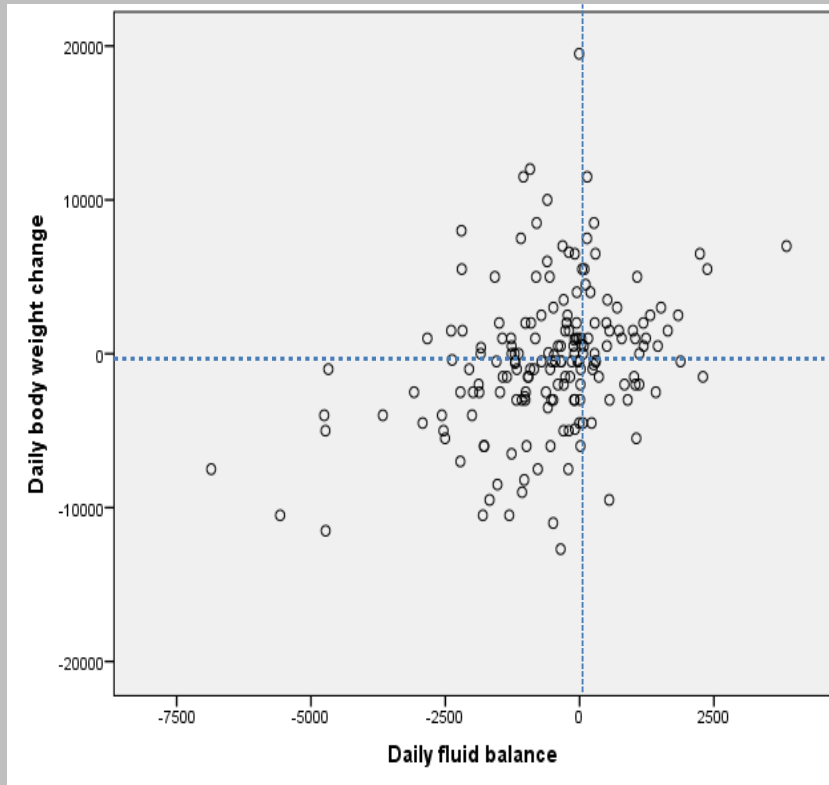
	Survivors n = 48	Non-survivors n = 13	p
Median (range), mL	Cumulative Fluid Balance*	Cumulative Fluid Balance*	
Day 1	+ve263 (-ve4,707 to +ve5,988)	+ve926 (-ve1960 to +ve2,799)	0.560
Start CRRT	+ve779 (-ve4,707 to +ve11,095)	+ve2011 (-ve1960 to +ve4,594)	0.765
End CRRT	-ve254 (-ve19,563 to +ve8,555)	+ve1587 (-ve26,738 to +ve10,234)	0.187
ICU discharge/death	-ve602 (-ve18,614 to +ve24,182)	+ve1587 (-ve26,738 to +ve10,234)	0.164
median (range), kg	Cumulative Body Weight Change	Cumulative Body Weight Change	
Admission weight	81 (42-217)	89.5 (54.5-172)	0.788
Start CRRT	0 (-ve5.5 to +ve14)	0 (-ve5.0 to +ve11.5)	0.769
End CRRT	0 (-ve23.5 to +ve30.5)	+ve2.5 (-ve30.5 to +ve11.5)	0.217
ICU discharge/death	-ve1.5 (-ve23.5 to +ve30.5)	+ve2.5 (-ve30.5 to +ve11.5)	0.085

*UNCORRECTED for IWL

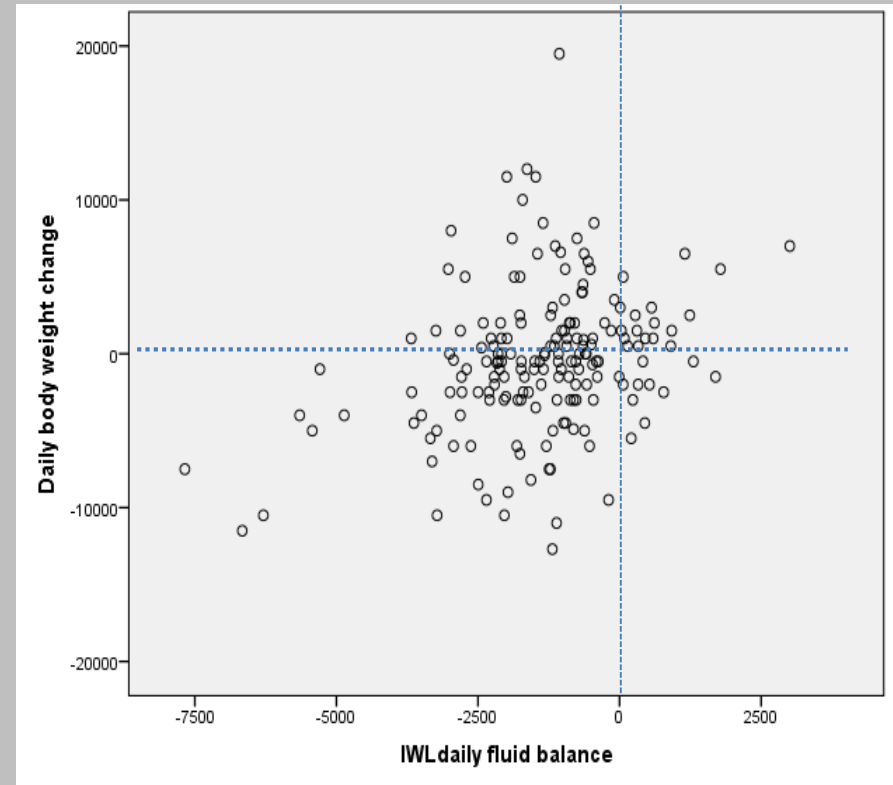
RESULTS Cont'd

- 98% of patients had baseline body weight <24hrs ICU admission
- Out of 403 opportunities to weigh patients compliance in weighing patients at midnight 71%
- One measured body weight was matched with calculated fluid balance in 39 patients
- Allowed 181 paired comparisons

RESULTS Cont'd

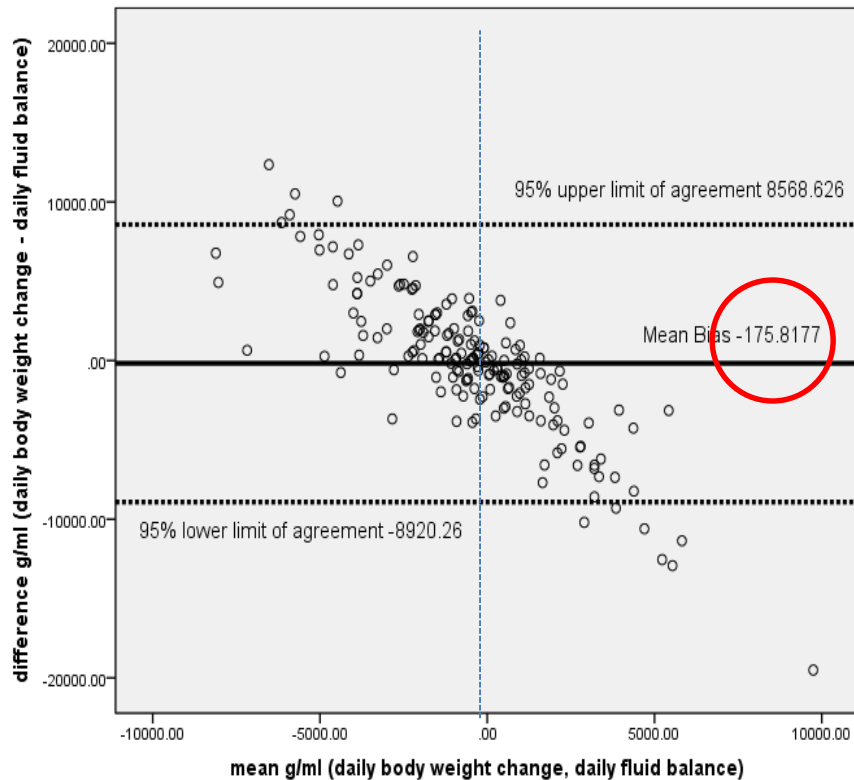


Correlation plots between 181 changes in body weight and daily fluid balance UNCORRECTED for IWL

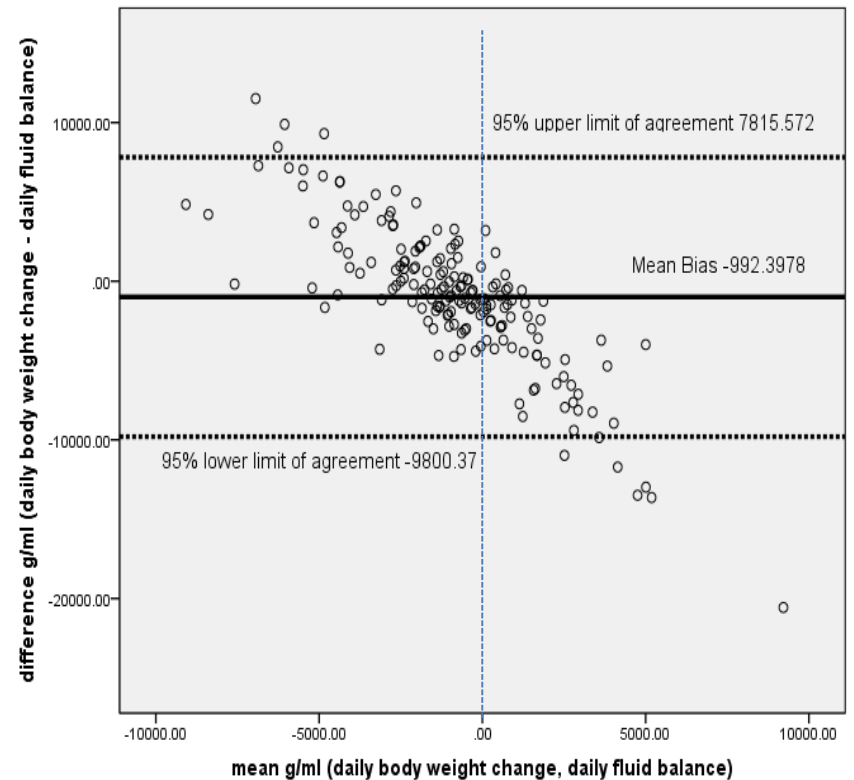


Correlation plots between 181 changes in body weight and daily fluid balance CORRECTED for IWL

RESULTS Cont'd



Bland-Altman plot between 181 changes in body weight and daily fluid balance UNCORRECTED for IWL



Bland-Altman plot between 181 changes in body weight and daily fluid balance CORRECTED for IWL

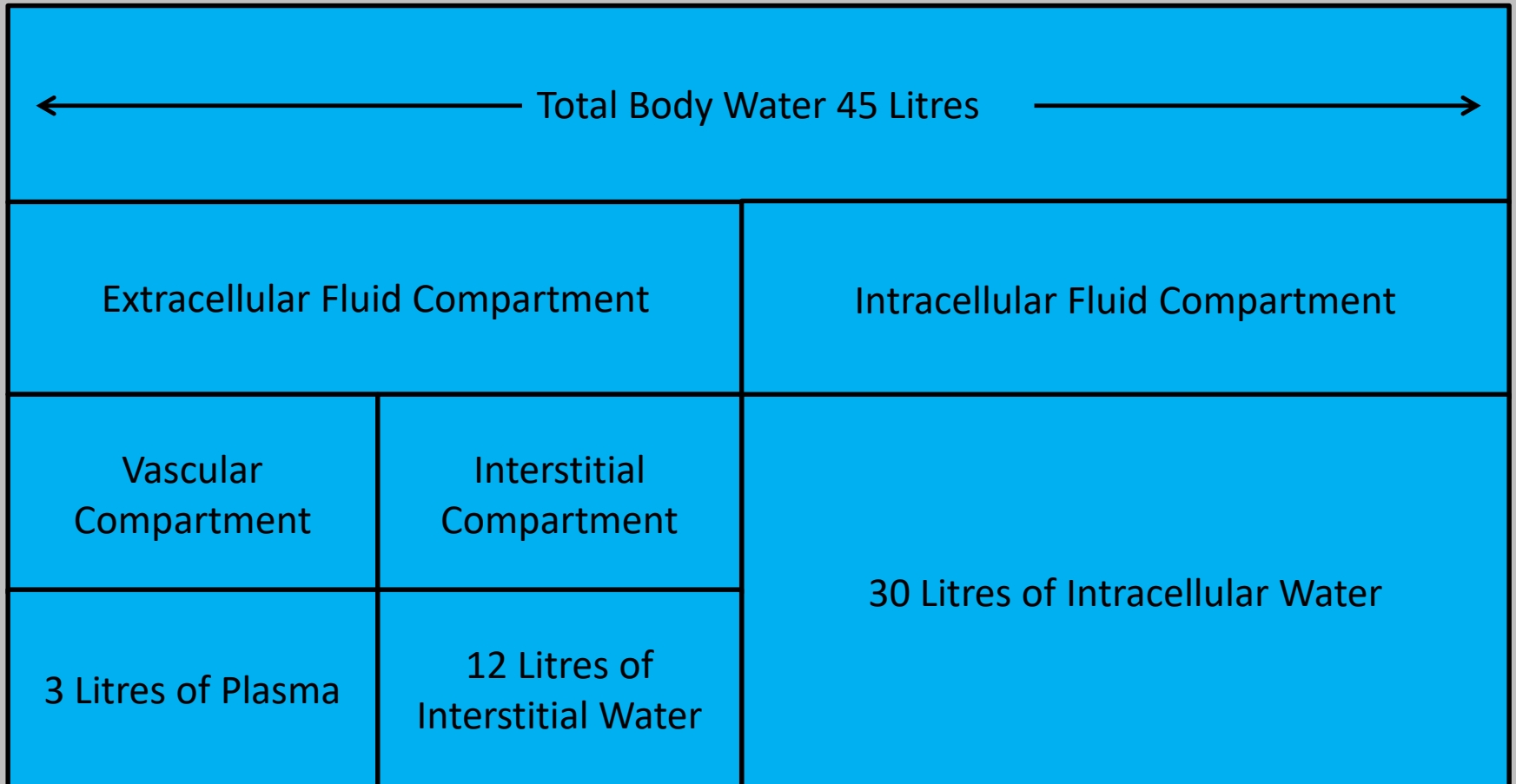
DISCUSSION

- Definitions
- Body Fluid Compartments
- Estimation of Body fluid status
- Fluid management
- Pathophysiology of fluid overload
- Significance of fluid overload
- Challenges of maintaining a fluid balance
- Challenges of measuring body weight

Definitions

- Daily Fluid Balance
- Cumulative Fluid Balance
- Positive Fluid Balance
- Fluid Overload
- % of Fluid Overload adjusted for Body Weight
- Cumulative Body Weight Change
- 1mL = 1g

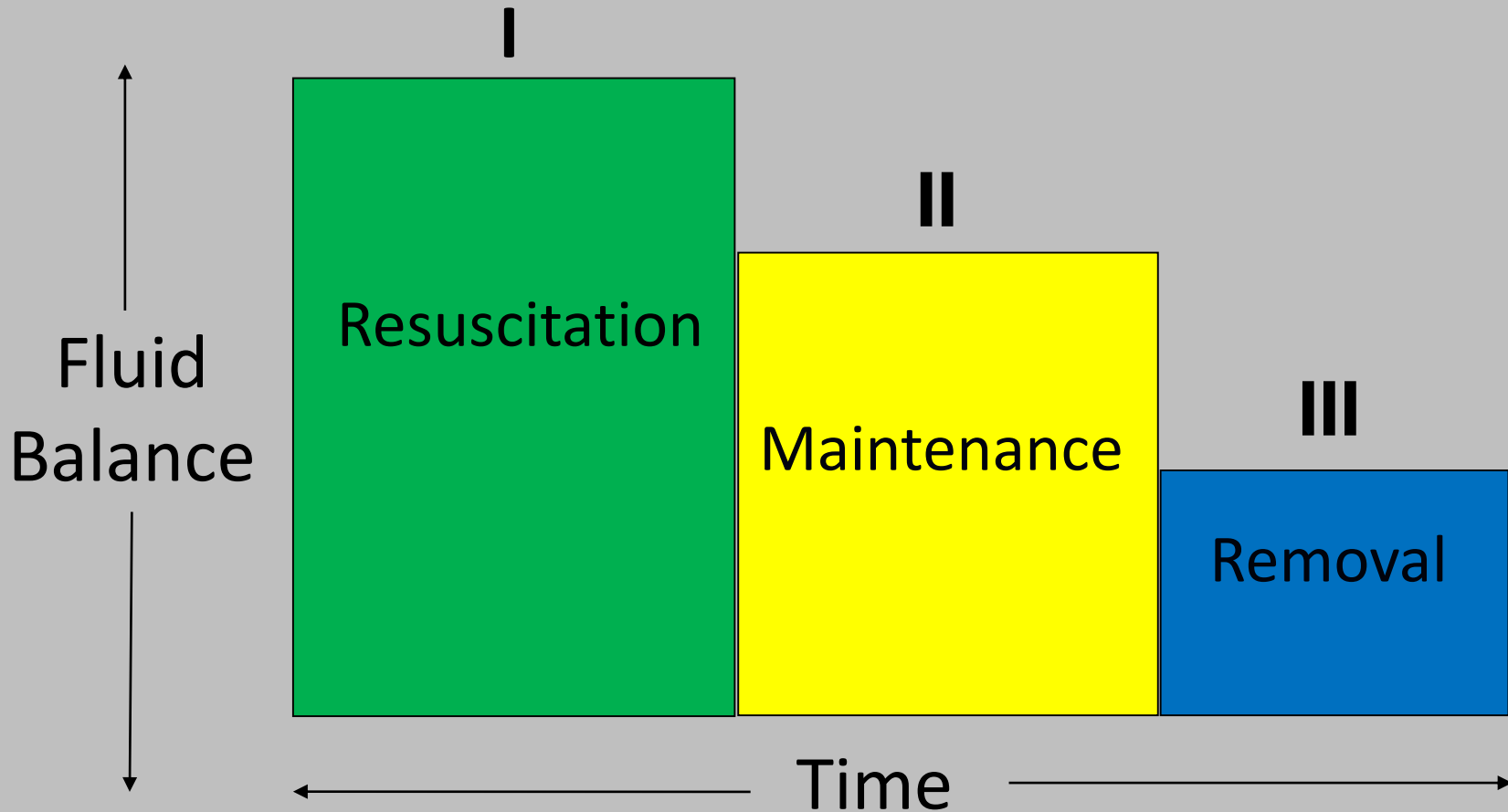
Body Fluid Compartments



Estimation of Body Fluid Status

- Physical examination
- Haemodynamic parameters
- Filling pressures (CVP, PAWP)
- Haemodynamic monitoring (PAC or PiCCO)
- Radiological techniques (CXR)
- Bioelectric impedance tomography
- Tritium indicator dilution

Fluid Management



Goldstein SL. Fluid Management in Acute Kidney Injury. *Journal of Intensive Care Medicine*. 2014;29(4):183-9.

Pathogenic Mechanism



Impaired Na^+ Excretion

The diagram shows a cross-section of a kidney with a yellow renal pelvis and red renal pyramids. The renal cortex is shown with a network of blood vessels. The overall appearance is normal, representing the state before the pathogenic mechanism begins.

Hyperchloremia (0.9% saline)



Interstitial Oedema

The diagram shows a cross-section of a kidney with a yellow renal pelvis and red renal pyramids. The renal cortex is shown with a network of blood vessels. The overall appearance is normal, representing the state before the pathogenic mechanism begins.

↑ Internal Pressure

↓ Blood Flow

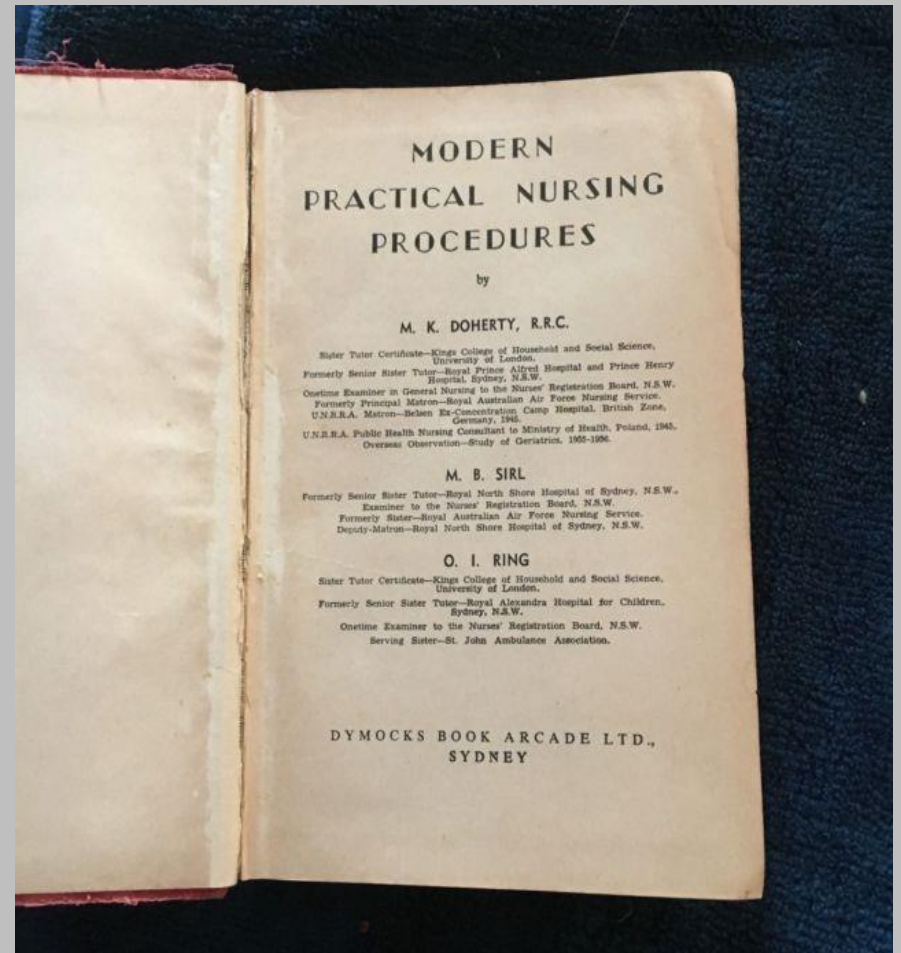
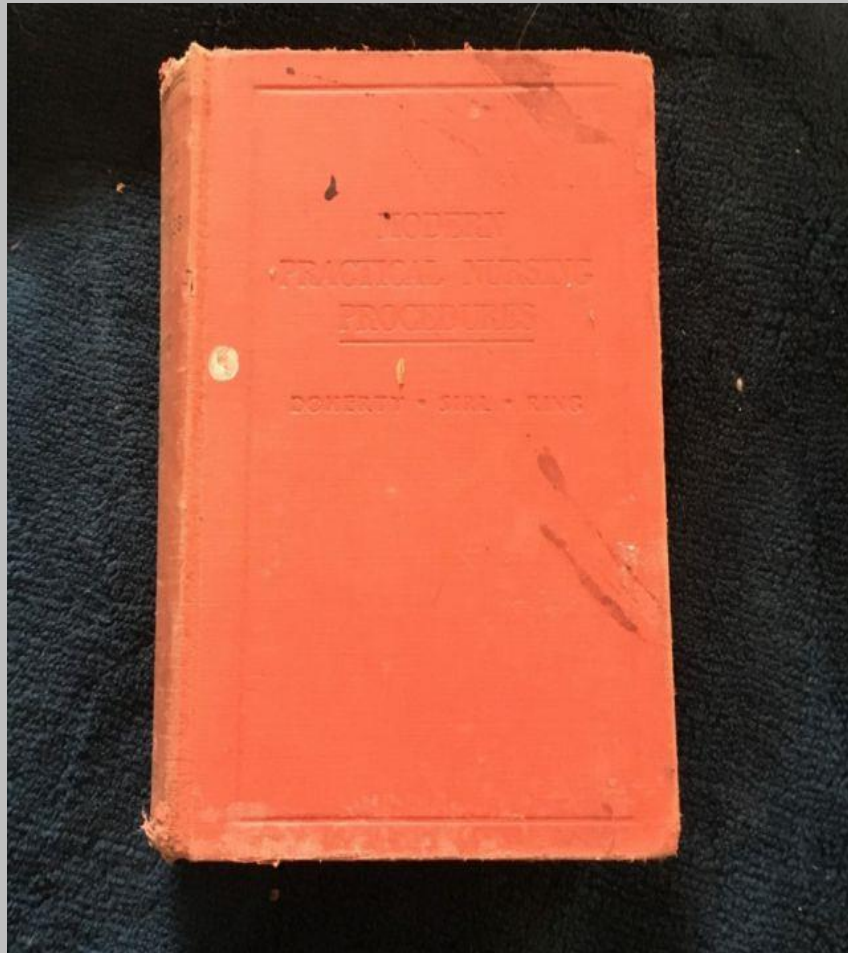
Fluid Overload

- AKI & fluid overload ↑ morbidity & mortality (Payen et al. 2008)
- +veFB associated with weaning & extubation failure (Upadya et al. 2005 & Frutos-Vivar et al. 2006)
- Severity of fluid overload with AKI influences renal recovery (Bouchard et al. 2009)
- Daily -ve mean FB ↑ outcomes (RENAL study 2012)
- Based on daily or cumulative FB totals

Fluid Balance Chart - Advantages

- 'Routine' nursing practice
- Cheap! – does not require technology
- Intuitive & simple
- Easily performed
- Provides quantitative & qualitative data
- Continuous daily monitoring & cumulative trend of fluid balance.
- Estimation of positive fluid accumulation

‘..part of nursing culture..’



Fluid Balance Chart - Disadvantages

- Subject to errors (paper or electronic)
- Only records on what is charted
- Subject to calculation errors (Asfour 2016; Diacon et al. 2014 & Perren et al. 2011)
- Non-recordable losses (IWL)
- Lack of accuracy breeds complacency

Daily Patient Weighing - Advantages

- Considered by some as the 'Gold Standard'
- 1kg weight loss = 1L change in body fluid
- Body weight influenced by body fluid...<7 days
- Body weight ↑ first 7 ICU days associated with ↑ LOS & ↓ survival (You et al. 2013)

Daily patient weighing - Disadvantages

- Hoist & weigh (not without risks!)
- Weigh capable beds (expensive option)
- Requires standardisation of procedures to improve accuracy (Schneider et al. 2012)
- Timing & consistency important
- Requires training & reminders to become part of standard care

CONCLUSION

- Few studies have evaluated benefits of maintaining a fluid balance chart
- Fluid overload can impede recovery & worse... ↑mortality
- Exercise caution when making clinical decisions based solely on daily & cumulative fluid balance calculations

Conclusion (cont'd)

- Weight-based measurements performed daily can improve estimation of body fluid status but...
- Additional physical & other assessments are required
- Are there other non-invasive alternatives?
- Would/Could you conduct an RCT – FLUID BALANCE versus BODY WEIGHT ?

So What's Next

- Systematic review on the *'Effectiveness of daily fluid balance charting compared with the measurement of body weight for the estimation of body fluid status of critically ill adult patients'*
- Future plans to investigate the 'usefulness' of maintaining a fluid balance chart
 - No daily fluid balances
 - No body weight
 - Clinical assessment only

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