

**Process-of-care in the ICU:
A multi-method exploration of an electronic
checklist to support medical morning rounds**

Karena Conroy

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Certificate of Authorship/Originality

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of candidate

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List of Abbreviations

ACSQHC	Australian Commission for Safety and Quality in Health Care
AE	Adverse Event
AERA	American Educational Research Association
AHRQ	Agency for Healthcare Research and Quality
ANZ	Australia and New Zealand
ANZICS	Australian and New Zealand Intensive Care Society
APA	American Psychological Association
APACHE	Acute Physiological, Age and Chronic Health Evaluation
API	Application Programming Interface
apps	Software applications
BI	Bias Index
BSL	Blood Sugar Level
CDSS	Clinical Decision Support System
CEC	Clinical Excellence Commission
CI	Confidence Interval
CIS	Clinical Information System
CL	Central Line
CLAB	Central Line Associated Bacteraemia
CLABSI	Central Line Associated Bloodstream Infection
COW	Computer-On-Wheels
CR-BSI	Catheter Related-Blood Stream Infection
CRF	Case Report Form
CTG	ANZICS Clinical Trials Group
CUSP	Comprehensive Unit-based Safety Program
CVC	Central Venous Catheter
CVI	Content Validity Index
DVT	Deep Venous Thromboembolism
EBM	Evidence-Based Medicine
e-checklist	Electronic checklist

FASTHUG	Feeding, Analgesia, Sedation, Thrombo-prophylaxis, Head-of-bed elevation, stress Ulcer prevention, Glucose control
GEE	Generalized Estimating Equations
GI	Gastro-Intestinal
HDU	High Dependency Unit
HOB	Head-of-Bed
HREC	Human Research Ethics Committee
ICCMU	Intensive Care Coordination and Monitoring Unit
ICU	Intensive Care Unit
IHI	Institute of Healthcare Improvement
IoM	Institute of Medicine
IQR	Inter-Quartile Range
IV	Intra-Venous
JVM	Java Virtual Machine
LOS	Length of stay
M&M	Morbidity & Mortality
MAC	Macintosh computer
MET	Medical Emergency Team
MRN	Medical Record Number
NA	Not Applicable
NCME	National Council on Measurement in Education
NHMRC	National Health and Medical Research Council
NICE SUGAR	Normoglycaemia in Intensive Care Evaluation (NICE) and Survival Using Glucose Algorithm Regulation (SUGAR)
NICS	National Institute of Clinical Studies
NICU	Neonatal Intensive Care Unit
NSW	New South Wales
NUM	Nurse Unit Manager
OR	Odds Ratio
PC	Personal Computer
PDA	Personal Digital Assistant
PDSA	Plan-Do-Study-Act
PI	Prevalence Index

PICU	Paediatric Intensive Care Unit
PIMS	Performance Indicators and Medication Safety
Pneg	Proportion of negative agreement
Ppos	Proportion of positive agreement
Pt	Patient
QI	Quality Improvement
QUM	Quality Use of Medicines
RCT	Randomised Controlled Trials
SAQ	Safety Attitudes Questionnaire
SD	Standard Deviation
SPC	Statistical Process Control
SPSS	Statistical Package for the Social Sciences
SUP	Stress Ulcer Prophylaxis
TPN	Total Parenteral Nutrition
US	United States of America
UK	United Kingdom
VAP	Ventilator-Associated Pneumonia
VTE	Venous Thrombo-Embolism
WHO	World Health Organization

Glossary of Terms

APACHE	Predicted risk of death score calculated using the worst physiological values in the first 24 hours and other patient and admission data
FASTHUG	Mnemonic for use by ICU clinicians at bedside e.g. during patient rounds
MRN	Medical record numbers are unique patient identifiers, specific to each individual hospital.
PDA	An electronic handheld computer
PDSA	Model for implementing and evaluating quality improvement strategies
Process-of-care	Practices involved in the delivery of care
SPC	Statistical process control is a method of analysing data that utilises control charts to display variation in process data over time.

Abstract

The need for comprehensive and effective methods to ensure the delivery of required processes of care to intensive care unit (ICU) patients is acknowledged globally. In response various tools have been implemented, although many have not yet been empirically tested or rigorously evaluated in ICUs. Early evidence suggests that using a checklist is one way of ensuring evidence-based or accepted processes of care are performed routinely and systematically.

The aim of this program of study was to identify areas of need, then develop, validate, test and evaluate an electronic process-of-care checklist (e-checklist) for use by intensive care physicians during morning ward rounds in a tertiary-level adult ICU. Need for improvements in the delivery of ICU processes of care were identified via a comprehensive literature search, a point prevalence study of 50 Australian and New Zealand ICUs, and baseline data collected at the local ICU level.

Evidence on checklist validity was obtained via multiple methods at different research stages: comparison of checklist responses and documentation of care recorded in patients' medical records demonstrated high correlations for each care component, providing support for its concurrent validity; local clinician interviews and a modified-Delphi technique using an expert clinician panel confirmed the relevance and adequacy of content and produced a list of clear, concise and descriptive checklist statements; high levels of concordance between clinician and auditor responses during the intervention phase contributed evidence to the e-checklist's construct validity based on response processes; and user feedback obtained before and after the intervention demonstrated the e-checklist had face validity with ICU physicians. Importantly, the prospective before-after intervention study demonstrated improved compliance with processes of care over time (odds ratios ranged from 1.9 for mechanical ventilation weaning to 22.9 for pain management) and user-satisfaction was achieved.

Implications for practice include implementing this versatile tool at the point-of-care to collect real-time, process-of-care data that can be completed by clinicians delivering and auditing care. Recommendations for further research include: testing for reliability; investigating the reasons for practice variability and impact on outcomes; conducting observations of e-checklist utility in clinical practice and in larger multi-centre studies

adequately powered to detect significant differences in patient outcomes over time; and comparing the e-checklist with other clinical support tools or across different delivery platforms such as tablet PCs.

Overall, this research demonstrated the utility of an e-checklist in measuring and improving the delivery of ICU processes of care and provided a substantial amount of evidence in support of its' construct validity.