Cognitive Aids

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research.mater.org.au

Cognitive aids

What is a cognitive aid?

How to evaluate a cognitive aid

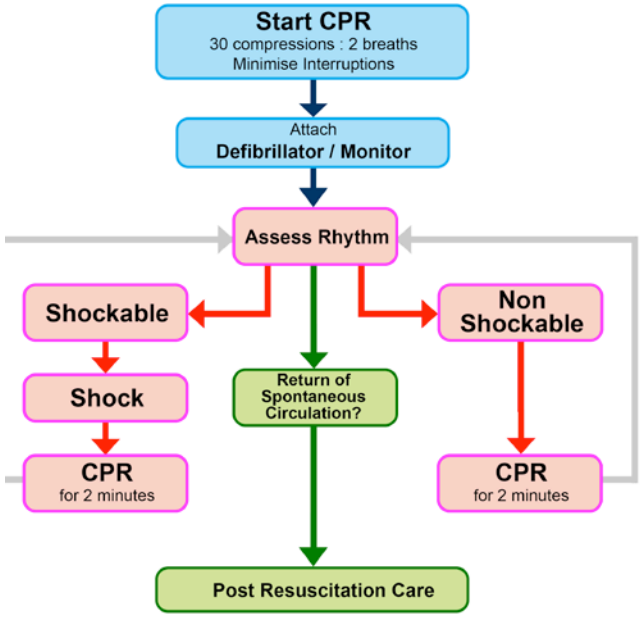
What are the dangers of cognitive aids?

How to develop a cognitive aid for your team

What is a cognitive aid?

A tool that reduces load on attention and working memory

- ✓ *Checklist*
- ✓ *Mnemonic*
- ✓ *Algorithm*
- ✓ *Decision diagram*
- ✓ *Flowchart*
- ✓ *Shelf/Organisation*



M R S O P A

D R S A B C D

Supports cognitive processes and contributes to Situation Awareness (Marshall, 2013).

Why use a cognitive aid?

DEMANDING CONDITIONS

Stress
Fatigue
Workload
Time pressure

COGNITIVE FUNCTION

Judgment
Compliance to standard procedure
Proficiency
Error

Healthcare teams are inherently "unstable"

(Andreatta, 2009)

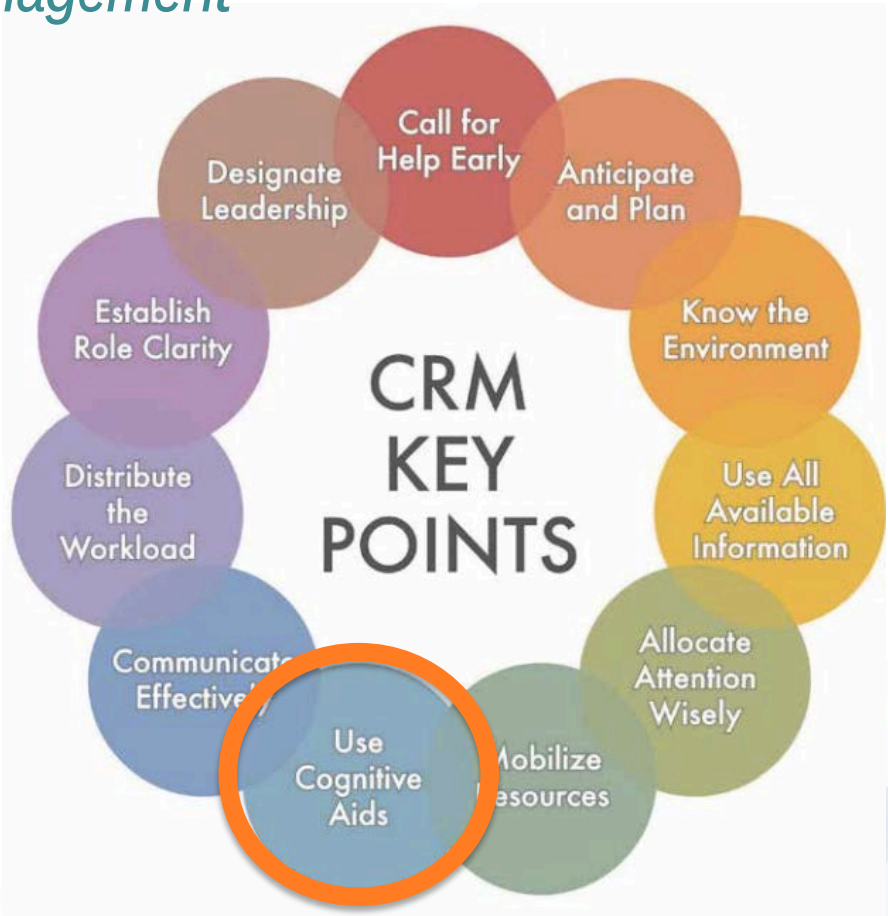
- ***Dynamic Forming***
- ***Limited time to prepare (prebrief)***
- ***Shift changes***

CRM: Aviation → Medicine

CRM Crew (or Crisis) Resource Management

CRM model for anaesthesia includes "use cognitive aids" *(Gaba, Fish & Howard, 1994)*

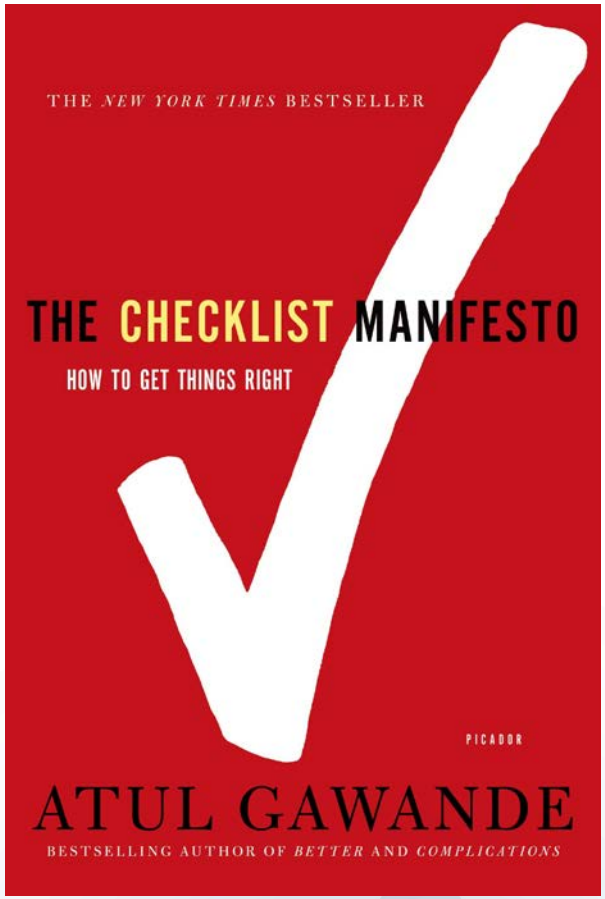
- ***Supports decision making***
  (Gaba, 2013)
- ***"Reader" reduces communication***
  (Burden et al., 2012)
- ***Supports team co-ordination***
  (Marshall, 2013)



Cognitive aids in medicine

WHO "safe surgery saves lives program"

Atul Gawande Alyson Aliano



World Health Organization

SURGICAL SAFETY CHECKLIST (FIRST EDITION)

Before induction of anaesthesia ▶▶▶▶▶▶▶▶▶ Before skin incision ▶▶▶▶▶▶▶▶▶▶▶▶▶ Before patient leaves operating room

SIGN IN

☐ **PATIENT HAS CONFIRMED**
- IDENTITY
- SITE
- PROCEDURE
- CONSENT

☐ **SITE MARKED/NOT APPLICABLE**

☐ **ANAESTHESIA SAFETY CHECK COMPLETED**

☐ **PULSE OXIMETER ON PATIENT AND FUNCTIONING**

DOES PATIENT HAVE A:

KNOWN ALLERGY?
☐ NO
☐ YES

DIFFICULT AIRWAY/ASPIRATION RISK?
☐ NO
☐ YES, AND EQUIPMENT/ASSISTANCE AVAILABLE

RISK OF >500ML BLOOD LOSS (7ML/KG IN CHILDREN)?
☐ NO
☐ YES, AND ADEQUATE INTRAVENOUS ACCESS AND FLUIDS PLANNED

TIME OUT

☐ **CONFIRM ALL TEAM MEMBERS HAVE INTRODUCED THEMSELVES BY NAME AND ROLE**

☐ **SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE VERBALLY CONFIRM**
- PATIENT
- SITE
- PROCEDURE

ANTICIPATED CRITICAL EVENTS

☐ **SURGEON REVIEWS:** WHAT ARE THE CRITICAL OR UNEXPECTED STEPS, OPERATIVE DURATION, ANTICIPATED BLOOD LOSS?

☐ **ANAESTHESIA TEAM REVIEWS**: ARE THERE ANY PATIENT-SPECIFIC CONCERNS?

☐ **NURSING TEAM REVIEWS:** HAS STERILITY (INCLUDING INDICATOR RESULTS) BEEN CONFIRMED? ARE THERE EQUIPMENT ISSUES OR ANY CONCERNS?

HAS ANTIBIOTIC PROPHYLAXIS BEEN GIVEN WITHIN THE LAST 60 MINUTES?
☐ YES
☐ NOT APPLICABLE

IS ESSENTIAL IMAGING DISPLAYED?
☐ YES
☐ NOT APPLICABLE

SIGN OUT

NURSE VERBALLY CONFIRMS WITH THE TEAM:

☐ **THE NAME OF THE PROCEDURE RECORDED**

☐ **THAT INSTRUMENT, SPONGE AND NEEDLE COUNTS ARE CORRECT** (OR NOT APPLICABLE)

☐ **HOW THE SPECIMEN IS LABELLED** (INCLUDING PATIENT NAME)

☐ **WHETHER THERE ARE ANY EQUIPMENT PROBLEMS TO BE ADDRESSED**

☐ **SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE REVIEW THE KEY CONCERNS FOR RECOVERY AND MANAGEMENT OF THIS PATIENT**

TO FIT LOCAL PRACTICE ARE ENCOURAGED.

Table 5. Outcomes before and after Checklist Implementation, According to Site.*

Site No.	No. of Patients Enrolled		Surgical-Site Infection		Unplanned Return to the Operating Room		Pneumonia		Death		Any Complication	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
							percent					
1	524	598	**4.0**	**2.0**	**4.6**	**1.8**	0.8	1.2	**1.0**	**0.0**	**11.6**	**7.0**

BMJ Quality & Safety

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✓ Increased safety attitudes

Article Text

Article info

Citation Tools

ERROR MANAGEMENT

Changes in safety attitude and relationship to decreased postoperative morbidity and mortality following implementation of a checklist-based surgical safety intervention FREE

Alex B Haynes[1], Thomas G Weiser[1], William R Berry[1], Stuart R Lipsitz[2], Abdel-Hadi S Breizat[3], E Patchen Dellinger[4], Gerald Dziekan[5], Teodoro Herbosa[6], Pascience L Kibatala[7], Marie Carmela M Lapitan[8], Alan F Merry[9], Richard K Reznick[10], Bryce Taylor[10], Amit Vats[11], Atul A Gawande[1], for the Safe Surgery Saves Lives Study Group

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SPECIAL ARTICLE

A Surgical Safety Checklist to Reduce Morbidity and Mortality in a Global Population

Alex B. Haynes, M.D., M.P.H., Thomas G. Weiser, M.D., M.P.H., William R. Berry, M.D., M.P.H., Stuart R. Lipsitz, Sc.D., Abdel-Hadi S. Breizat, M.D., Ph.D., E. Patchen Dellinger, M.D., Teodoro Herbosa, M.D., Sudhir Joseph, M.S., Pascience L. Kibatala, M.D., Marie Carmela M. Lapitan, M.D., Alan F. Merry, M.B., Ch.B., F.A.N.Z.C.A., F.R.C.A., Krishna Moorthy, M.D., F.R.C.S., Richard K. Reznick, M.D., M.Ed., Bryce Taylor, M.D., and Atul A. Gawande, M.D., M.P.H., for the Safe Surgery Saves Lives Study Group*

N Engl J Med 2009; 360:491-499 | January 29, 2009 | DOI: 10.1056/NEJMsa0810119

Cognitive aids in medicine

Central Line infections checklist

Baseline… median infection rate = 2.7 (per 1,000 catheter days)

- ❑ *Hand Hygiene*
- ❑ *Prep site with antiseptic*
- ❑ *Use full-barrier precautions (cap, gloves, gown, mask, drape)*
- ❑ *Use subclavian vein where possible (not jugular or femoral site)*
- ❑ *Remove unnecessary catheters*

3 months later… median infection rate = ***0***

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 DECEMBER 28, 2006 VOL. 355 NO. 26

An Intervention to Decrease Catheter-Related Bloodstream Infections in the ICU

Peter Pronovost, M.D., Ph.D., Dale Needham, M.D., Ph.D., Sean Berenholtz, M.D., David Sinopoli, M.P.H., M.B.A., Haitao Chu, M.D., Ph.D., Sara Cosgrove, M.D., Bryan Sexton, Ph.D., Robert Hyzy, M.D., Robert Welsh, M.D., Gary Roth, M.D., Joseph Bander, M.D., John Kepros, M.D., and Christine Goeschel, R.N., M.P.A.

Why people don't use cognitive aids

- *Perceived as "more paperwork" (Gawande, 2007)*
- *"Don't have time" (Gawande, 2007)*
- *"Cheat sheet"*
- *Clinical and educational culture (Marshall, 2013)*

Cognitive aids in medicine

WHO Surgical Safety Checklist

20% of doctors said it's a "waste of time"

but…

94% would want it used if they were the patient

Atul Gawande Alyson Aliano

World Health Organization

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TO FIT LOCAL PRACTICE ARE ENCOURAGED.

Cognitive aids in medicine

Displaying cognitive aids during emergencies

- ✓ *Reduces omissions*
- ✓ *Reduces time to perform tasks*
- ✓ *Improves team skills*
- ✓ *Improves team communication*
- ✓ *Improves team performance*

Except where there are flaws in education, or physical design

Cognitive aids in medicine

Because design really does matter!

Journal of Perinatology

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Original Article

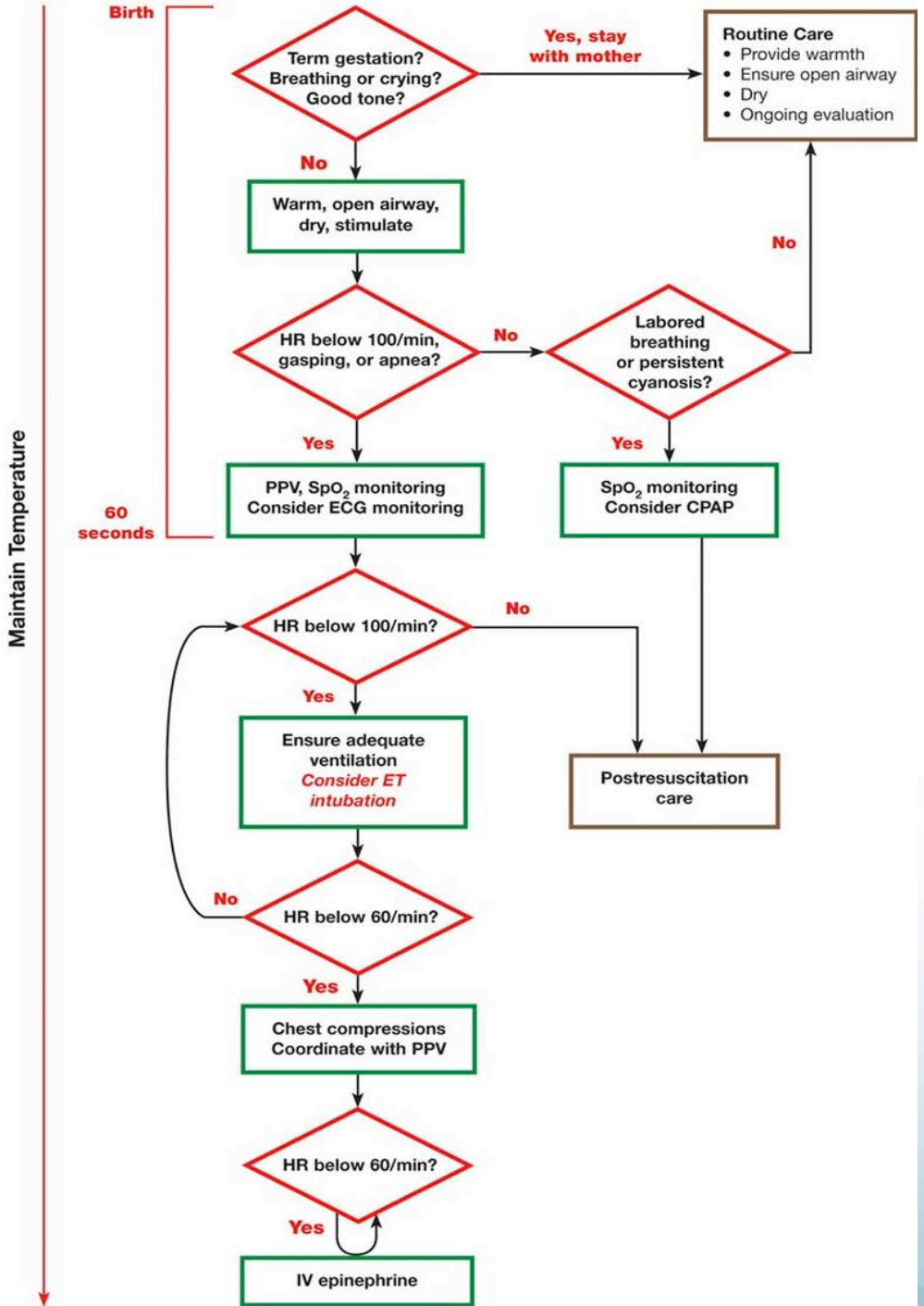
Journal of Perinatology (2017) **37,** 387–393; doi:10.1038/jp.2016.235; published online 22 December 2016

The cognitive aids in medicine assessment tool (CMAT) applied to five neonatal resuscitation algorithms

M L McLanders[1], S D Marshall[2], P M Sanderson[1,3,4] and H G Liley[4,5]

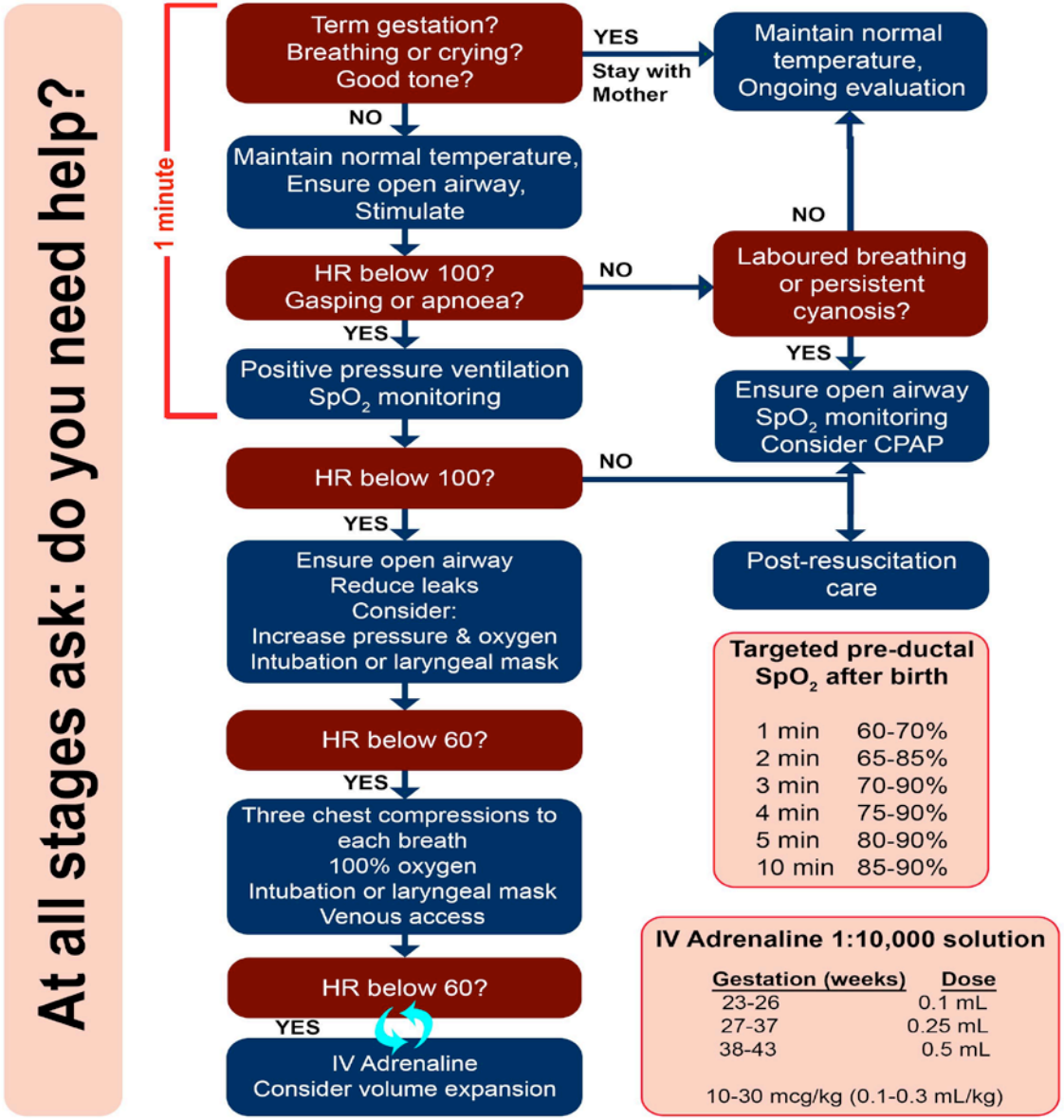
[1]School of Psychology, The University of Queensland, Brisbane, QLD, Australia
[2]Department of Anaesthesia and Perioperative Medicine, Monash University, Melbourne, VIC, Australia
[3]School of Information Technology and Electrical Engineering (ITEE), The University of Queensland, Brisbane, QLD, Australia
[4]School of Medicine, The University of Queensland, Brisbane, QLD, Australia
[5]Mater Research Institute, The University of Queensland, South Brisbane, QLD, Australia

ILCOR


Birth
Term gestation?
Breathing or crying?
Good tone?
Yes, stay with mother
Routine Care
• Provide warmth
• Ensure open airway
• Dry
• Ongoing evaluation
No
Warm, open airway, dry, stimulate
No
HR below 100/min, gasping, or apnea?
No
Labored breathing or persistent cyanosis?
Yes
Yes
PPV, SpO2 monitoring
Consider ECG monitoring
SpO2 monitoring
Consider CPAP
60 seconds
Maintain Temperature
HR below 100/min?
No
Yes
Ensure adequate ventilation
Consider ET intubation
Postresuscitation care
No
HR below 60/min?
Yes
Chest compressions
Coordinate with PPV
HR below 60/min?
Yes
IV epinephrine

ANZCOR

Newborn Life Support



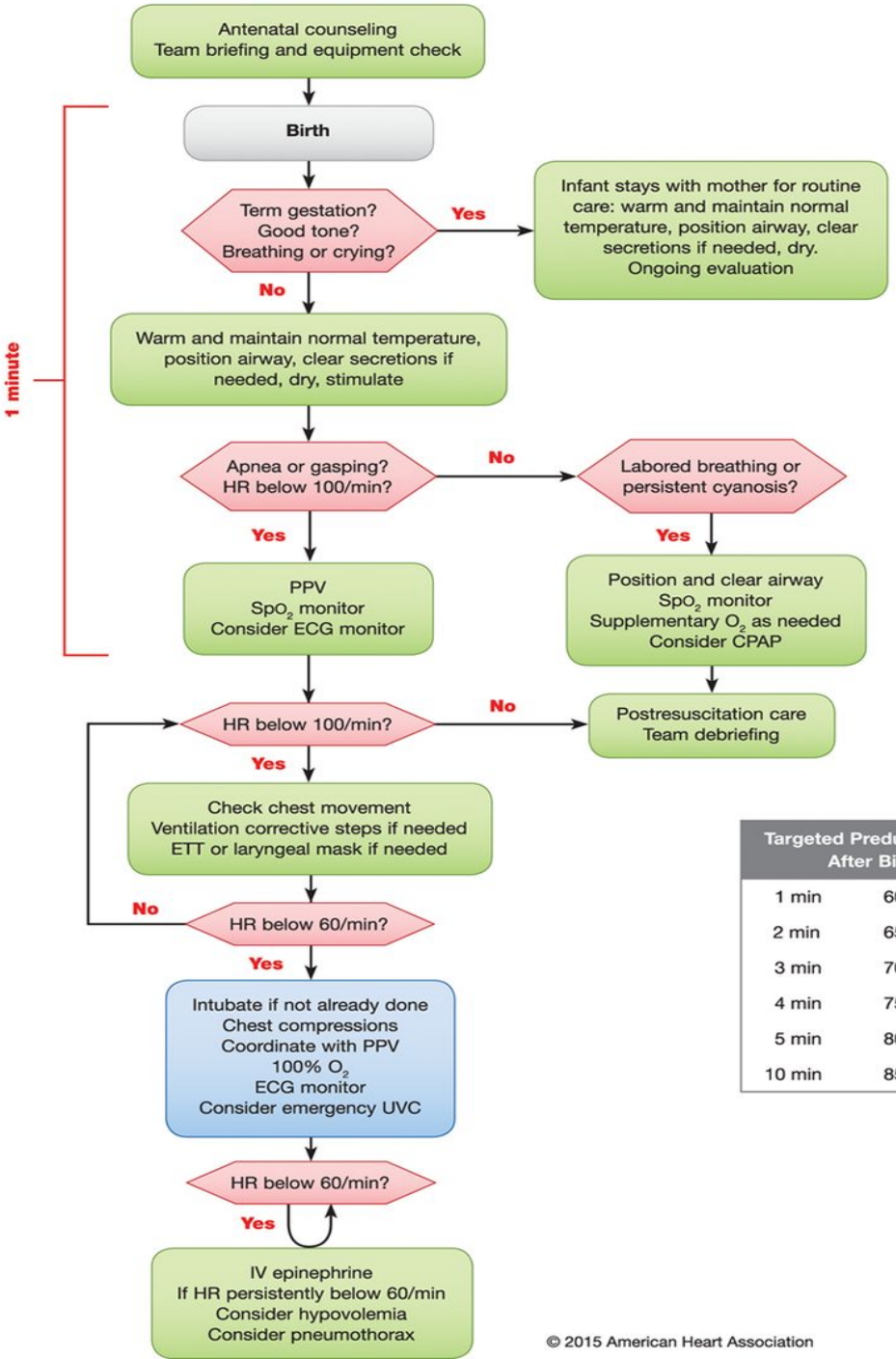
January 2016

AUSTRALIAN RESUSCITATION COUNCIL

NEW ZEALAND Resuscitation Council WHAKAHAUORA AOTEAROA

AHA

Neonatal Resuscitation Algorithm—2015 Update

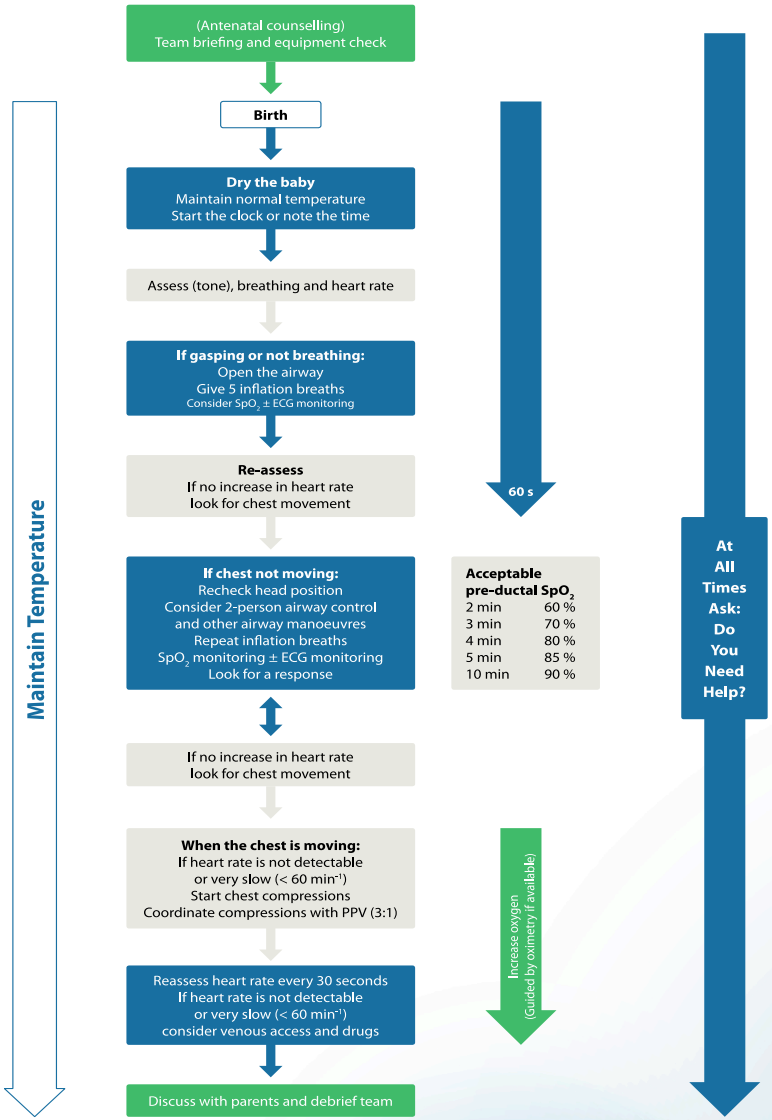


Targeted Preductal SpO_2 After Birth	
1 min	60%-65%
2 min	65%-70%
3 min	70%-75%
4 min	75%-80%
5 min	80%-85%
10 min	85%-95%

ERC

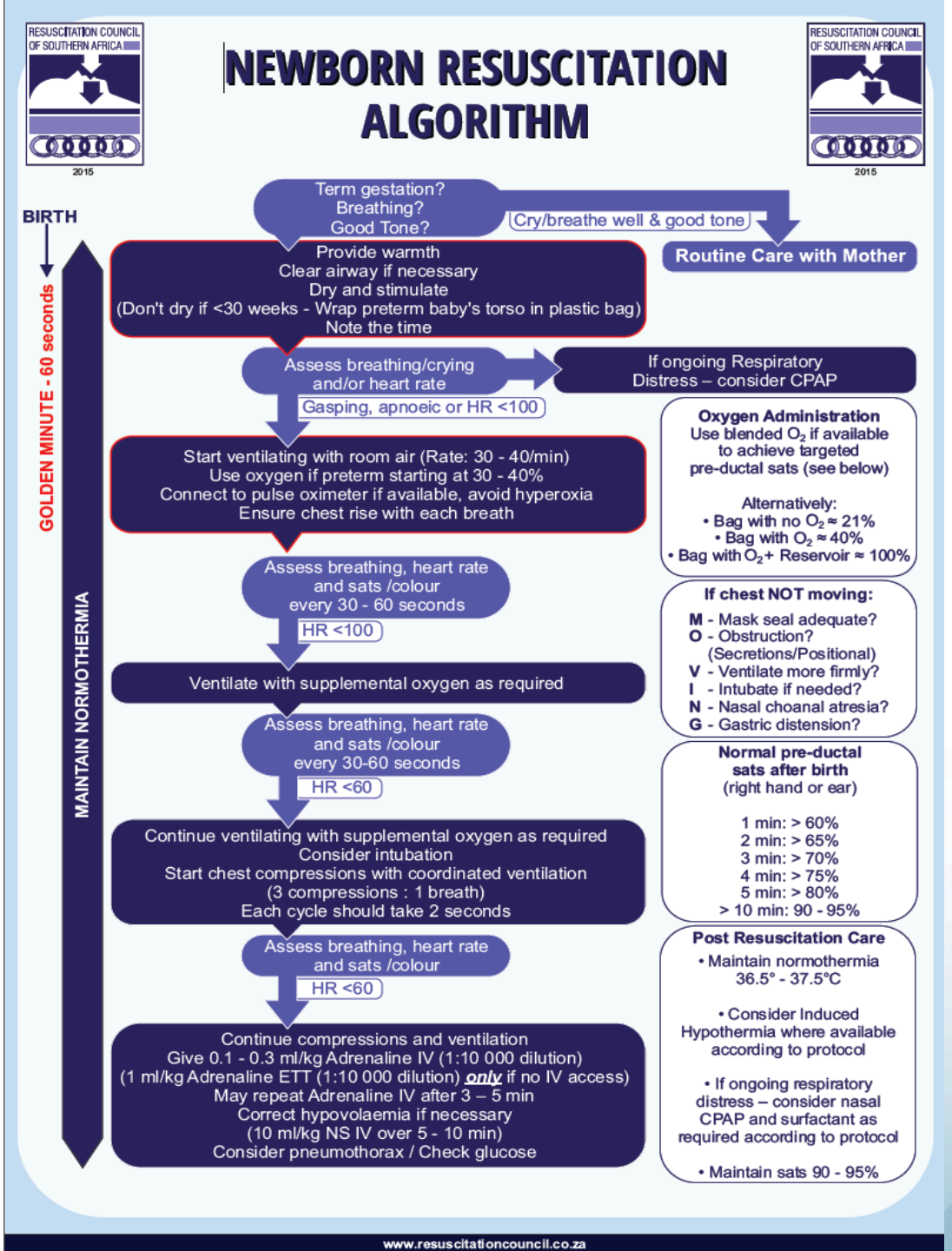
EUROPEAN RESUSCITATION COUNCIL

Newborn Life Support



www.erc.edu | info@erc.edu
Published October 2015 by European Resuscitation Council vzw, Emile Vanderveldelaan 35, 2845 Niel, Belgium
 Product reference: Poster_NLS_Algorithm_ENG_20150930

RCSA


RESUSCITATION COUNCIL OF SOUTHERN AFRICA
2015
NEWBORN RESUSCITATION ALGORITHM
RESUSCITATION COUNCIL OF SOUTHERN AFRICA
2015
BIRTH
GOLDEN MINUTE - 60 seconds
MAINTAIN NORMOTHERMIA
Term gestation?
Breathing?
Good Tone?
Cry/breathe well & good tone
Routine Care with Mother
Provide warmth
Clear airway if necessary
Dry and stimulate
(Don't dry if <30 weeks - Wrap preterm baby's torso in plastic bag)
Note the time
Assess breathing/crying and/or heart rate
If ongoing Respiratory Distress – consider CPAP
Gasping, apnoeic or HR <100
Start ventilating with room air (Rate: 30 - 40/min)
Use oxygen if preterm starting at 30 - 40%
Connect to pulse oximeter if available, avoid hyperoxia
Ensure chest rise with each breath
Oxygen Administration
Use blended O_2 if available to achieve targeted pre-ductal sats (see below)
Alternatively:
• Bag with no $O_2 \approx 21\%$
• Bag with $O_2 \approx 40\%$
• Bag with O_2 + Reservoir ≈ 100%
Assess breathing, heart rate and sats /colour every 30 - 60 seconds
HR <100
If chest NOT moving:
M - Mask seal adequate?
O - Obstruction? (Secretions/Positional)
V - Ventilate more firmly?
I - Intubate if needed?
N - Nasal choanal atresia?
G - Gastric distension?
Ventilate with supplemental oxygen as required
Assess breathing, heart rate and sats /colour every 30-60 seconds
HR <60
Normal pre-ductal sats after birth
(right hand or ear)
1 min: > 60%
2 min: > 65%
3 min: > 70%
4 min: > 75%
5 min: > 80%
> 10 min: 90 - 95%
Continue ventilating with supplemental oxygen as required
Consider intubation
Start chest compressions with coordinated ventilation
(3 compressions : 1 breath)
Each cycle should take 2 seconds
Assess breathing, heart rate and sats /colour
HR <60
Post Resuscitation Care
• Maintain normothermia 36.5° - 37.5°C
• Consider Induced Hypothermia where available according to protocol
• If ongoing respiratory distress – consider nasal CPAP and surfactant as required according to protocol
• Maintain sats 90 - 95%
Continue compressions and ventilation
Give 0.1 - 0.3 ml/kg Adrenaline IV (1:10 000 dilution)
(1 ml/kg Adrenaline ETT (1:10 000 dilution) only if no IV access)
May repeat Adrenaline IV after 3 – 5 min
Correct hypovolaemia if necessary
(10 ml/kg NS IV over 5 - 10 min)
Consider pneumothorax / Check glucose
www.resuscitationcouncil.co.za

Evaluation of CAs

Medical device design guidelines (Marshall, 2013)

1. *Content as per best practice guidelines*

1. *Appropriate for emergency use*

1. *Familiar format (as per training)*

1. *Supports team co-ordination*

CMAT Criteria

Domain 1 physical characteristics		
1.01	Document size	Is the size of the document appropriate to the space available?
1.02	Tabs and dividers	Are any tabs that are used clearly identified?
1.03	Font type	Does the font type used provide clear differentiation between characters?
1.04	Print size	Are the action points legible at arms' length?
1.05	Margins	Can you use your thumb as a cursor to keep track of progress through the cognitive aid?
1.06	Margins	Are all steps aligned to left?
1.07	Contrast and color	Has black text on a white or yellow background been used? Alert cues may be colored
1.08	Contrast and color	Where color shading has been used to discriminate actions or notes, is there sufficient contrast between the text and background?
1.09	Numbering	Are page numbers clearly identified?
1.10	Numbering	Are actions consecutively numbered?
Domain 2 content		
2.01	Structure	Has the number of action items been minimized to take account of time available to complete the cognitive aid?
2.02	Title	Does the cognitive aid have a title?
2.03	Title	Does the title fully reflect the failure condition?
2.04	Failure condition	Does the cognitive aid contain a description of the failure condition(s)?
2.05	Objective	Does the cognitive aid contain an objective?
2.06	Memory items	Are any memory items used listed at the beginning of the cognitive aid?
2.07	Memory items	Are any memory items clearly distinguished from the other action items?
2.08	Memory items	If used, are there six or fewer memory items?
2.09	Cautionary notes	Are any cautionary notes clearly discriminated?
2.10	Cautionary notes	Are any cautionary notes printed above the action item to which they relate?
2.11	Action items	Are any action items used distinguishable from the text?
2.12	Action items	Are the 'read' and 'do' items clearly linked?
2.13	Action items	Are any critical items discriminated?
2.14	Action items	Where appropriate, does the procedure explicitly state who is responsible for specific actions?
2.15	Explanatory notes	Are any explanatory notes clearly distinguished from action items?
2.16	Explanatory notes	Are those notes linked to the action item to which they relate?
2.17	Decision items	Are conditional steps clearly laid out?
2.18	Review of system status	Is a review of the clinical situation provided?
2.19	Deferred items	Is the presence or absence of deferred items clearly identified and necessary actions described?
Domain 3 layout and format		
3.01	Cognitive aids per page	If the cognitive aid runs onto a second page, is it split at a logical place?
3.02	Start and finish	Does the cognitive aid have a clearly defined start?
3.03	Start and finish	Does the cognitive aid have a defined end?
3.04	Start and finish	Are the 'end of xxx' indications provided in every place where the cognitive aid can be completed?
3.05	Continuation pages	Is it clear when the cognitive aid continues on to another page?
3.06	Order	Does the order of the action items ensure return to a safe state at the earliest opportunity?
3.07	Cross-referencing	Is cross-referencing minimized?
3.08	Cross-referencing	Where there is cross-referencing to other material is it appropriately signposted?
3.09	Figures and tables	Are any figures or tables clearly linked to the cognitive aid with which they are associated?
3.10	Figures and tables	Are the figures legible and usable?
3.11	Abbreviations and consistency	Do all captions and labels used in the cognitive aid correspond exactly to the words used in the clinical environment?
3.12	Abbreviations and consistency	Does the cognitive aid include a statement of currency (i.e. is it in date)
3.13	Abbreviations and consistency	Can the cognitive aid be made site-specific?

Physical characteristics

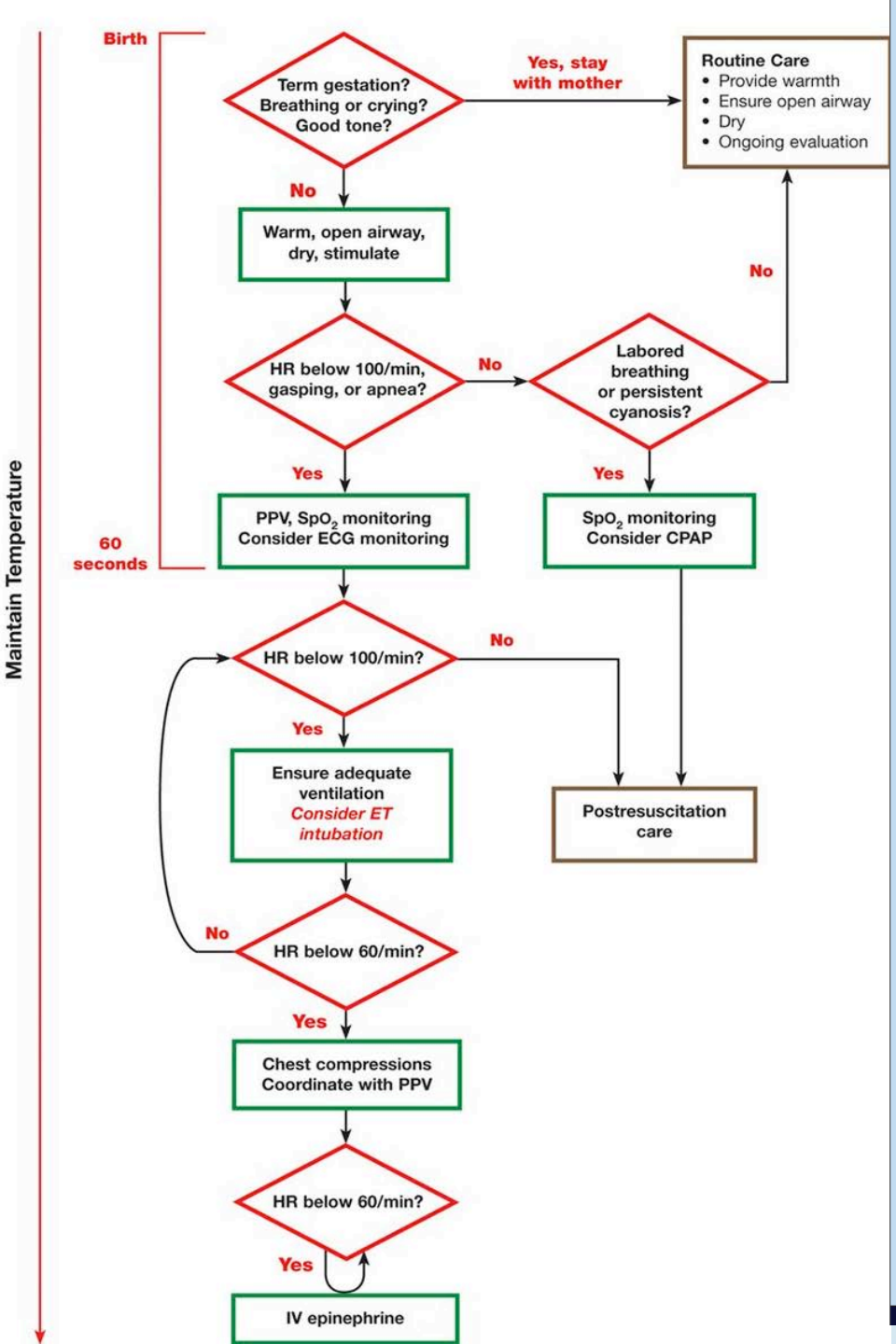
Content

Layout and format

Results

Algorithm	Applicable attributes	Score	CMAT adherence
ILCOR	30	32/60	53%
ANZCOR	31	28/62	45%
AHA	31	26/62	42%
ERC	31	30/62	48%
RCSA	31	24/62	39%

Limitations of CMAT → Designed for Checklists



NEWBORN RESUSCITATION ALGORITHM

RESUSCITATION COUNCIL OF SOUTHERN AFRICA 2015

BIRTH

Term gestation?
Breathing?
Good Tone?

Cry/breathe well & good tone → **Routine Care with Mother**

Provide warmth
Clear airway if necessary
Dry and stimulate
(Don't dry if <30 weeks - Wrap preterm baby's torso in plastic bag)
Note the time

Assess breathing/crying and/or heart rate

If ongoing Respiratory Distress – consider CPAP

Gasping, apnoeic or HR <100

Start ventilating with room air (Rate: 30 - 40/min)
Use oxygen if preterm starting at 30 - 40%
Connect to pulse oximeter if available, avoid hyperoxia
Ensure chest rise with each breath

Assess breathing, heart rate and sats /colour every 30 - 60 seconds

HR <100

Ventilate with supplemental oxygen as required

Assess breathing, heart rate and sats /colour every 30-60 seconds

HR <60

Continue ventilating with supplemental oxygen as required
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GOLDEN MINUTE - 60 seconds

MAINTAIN NORMOTHERMIA

Oxygen Administration
Use blended O_2 if available to achieve targeted pre-ductal sats (see below)

Alternatively:
- Bag with no O_2 ≈ 21%
- Bag with O_2 ≈ 40%
- Bag with O_2 + Reservoir ≈ 100%

If chest NOT moving:
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(right hand or ear)

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4 min: > 75%
5 min: > 80%
> 10 min: 90 - 95%

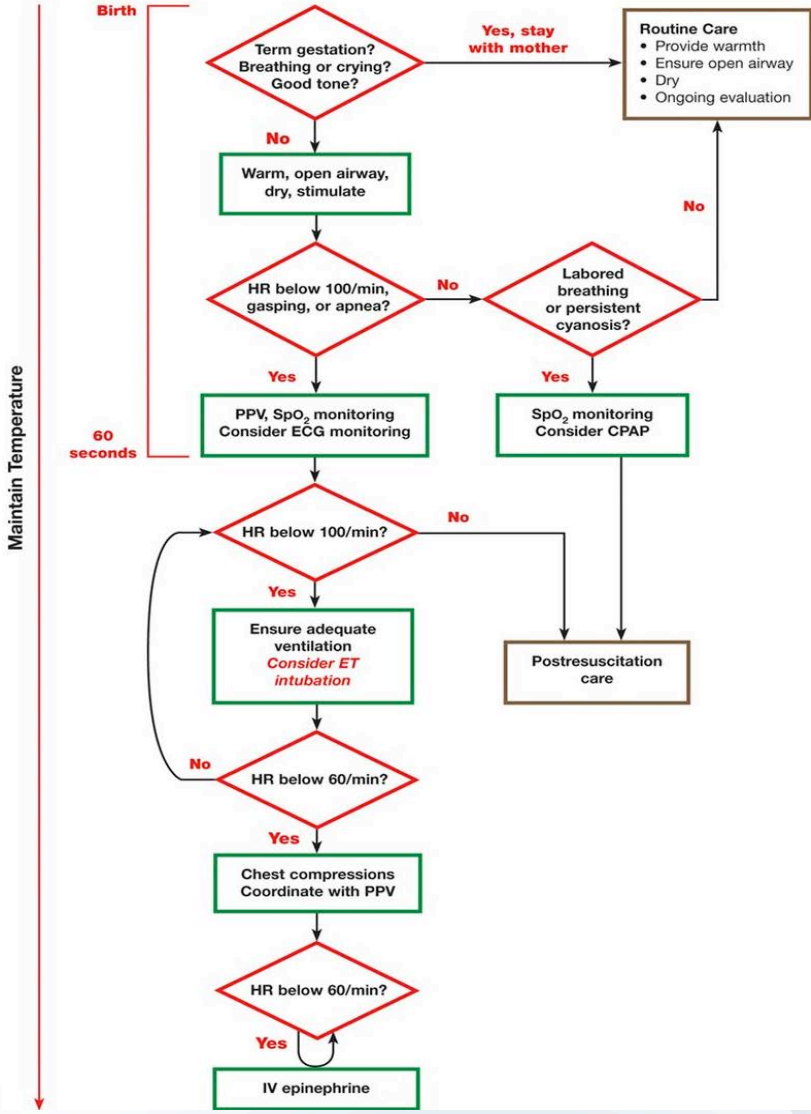
Post Resuscitation Care
- Maintain normothermia 36.5° - 37.5°C
- Consider Induced Hypothermia where available according to protocol
- If ongoing respiratory distress – consider nasal CPAP and surfactant as required according to protocol
- Maintain sats 90 - 95%

Design matters

Current Neonatal Resuscitation algorithm may not necessarily be the best support tool for teams

Some examples why…

- Not resilient to “special case” resuscitations
- Use of colour not easiest to read
- Infinite loop between IV epinephrine–HR<60



McLanders, M., Marshall, S., Sanderson, P., & Liley, H., Cognitive aids in Medicine Assessment Tool (CMAT) applied to five neonatal resuscitation algorithms. (2016) The Journal of Perinatology.

The dangers of poor design

1. *Can reinforce heuristics (treatment pathways)*

   (Raemer, 2015)

2. *Confusing user interface (e.g. Defibrillators accidentally turned off)*

   (Hoyer et al., 2008)

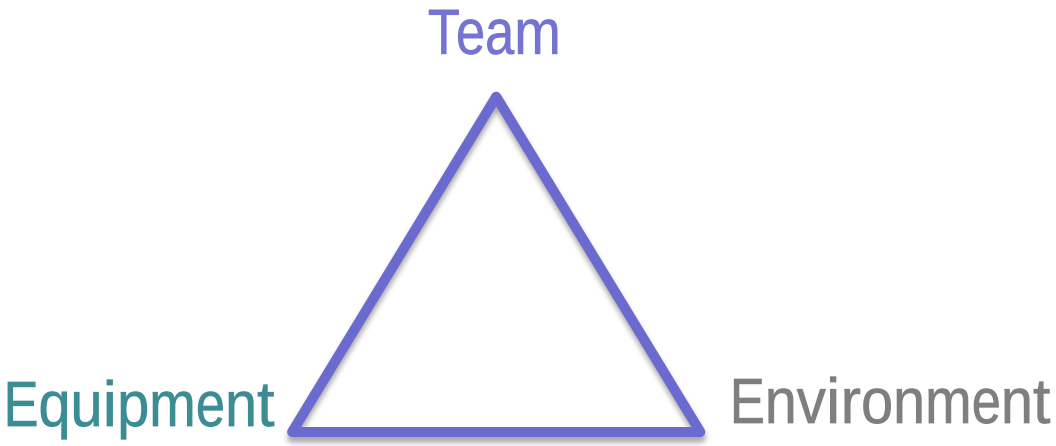
3. *Can lead to clinical error (e.g. programming errors in infusion pumps)*

   (Nemeth et al., 2009)

4. *Inflexible systems (e.g. Incorrect medication orders)*

   (Koppel et al, 2005)

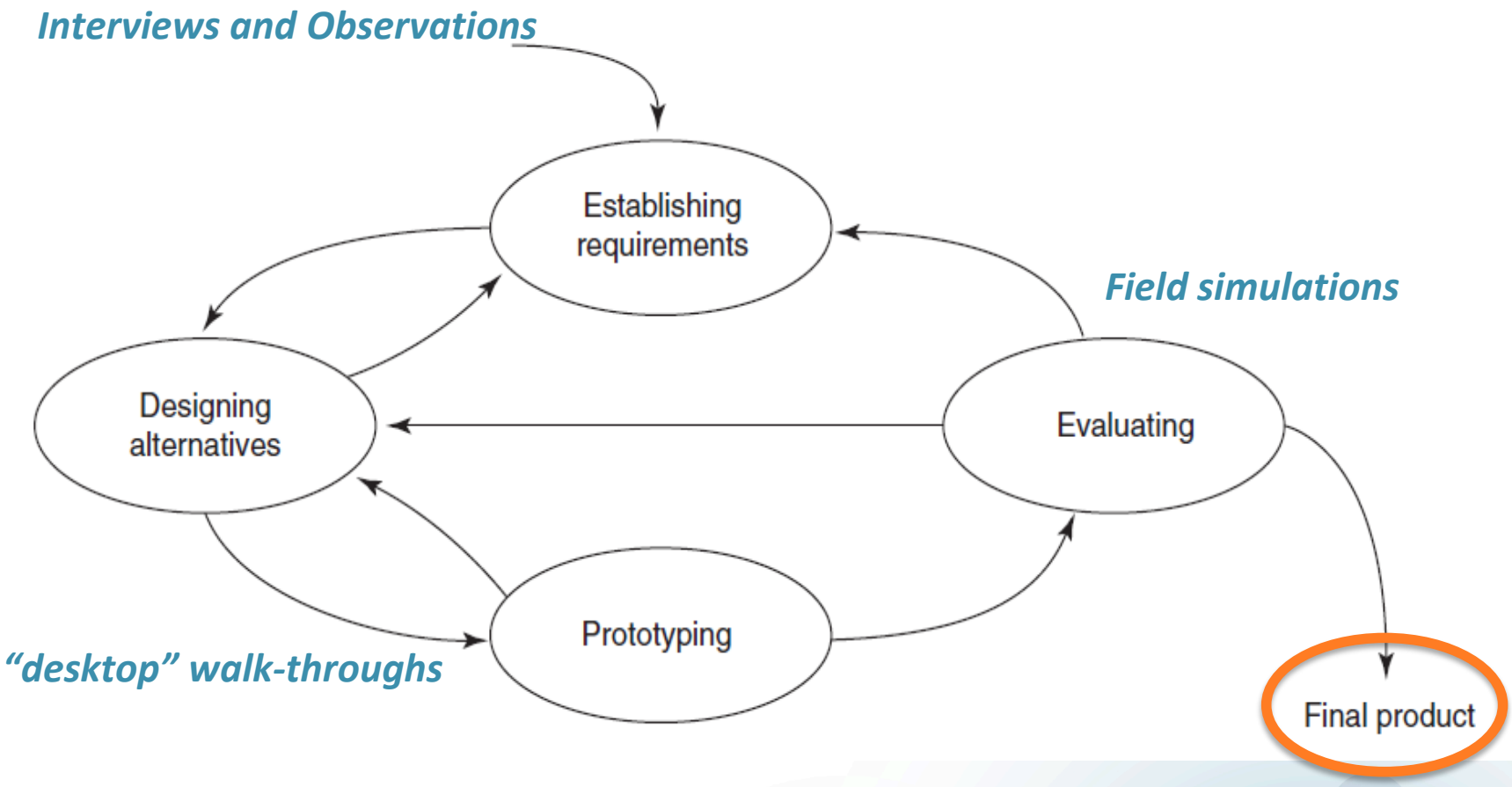
Effective design approach



Human Factors = Resilient Systems

- ***design to adapt to variability***
- ***maximise strengths, support limitations***

Interaction Design Process



User-centered, participatory design process

Example intervention

ELSEVIER

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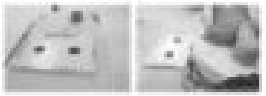
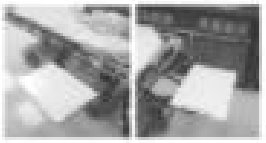
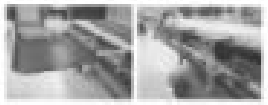
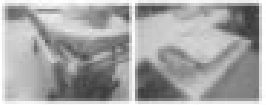
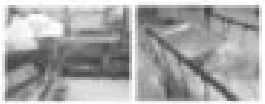
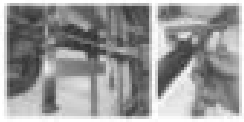
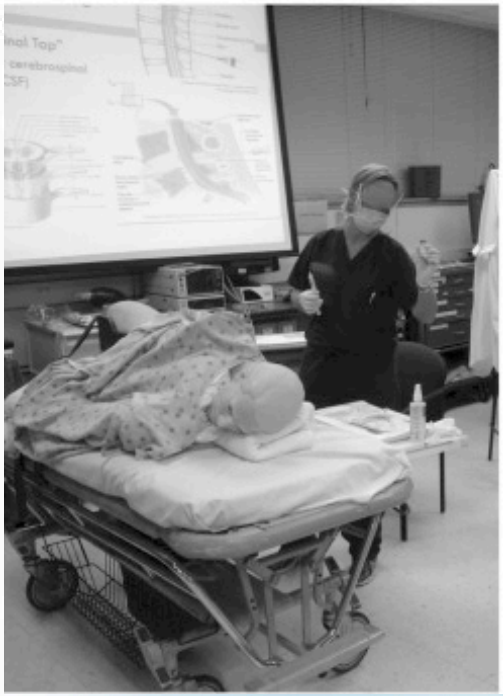
“we built a shelf”

Prototype	Image	Comments
Version 1		Underscores conditioning stabilization and support approach. Design abandoned because of excessive weight and unreliable securing mechanism.
Version 2		Real-time device attachment approach. Design abandoned because of unreliable securing mechanism and inconsistent surface leveling.
Versions 3 and 4		Use of off-the-shelf aluminum bracket and horizontal stabilizer bar to attach surface to stretcher bed rail. Revisions needed to improve stability and securing mechanism.
Version 5		Use of pelvic inserts to improve fit characteristics and securement. Continued revisions needed to improve securing mechanism.
Version 6		Selection of aviation steel tray to reduce weight and improve durability. Prototype now able to be mounted vertically or laterally on bed rails or other stable surfaces in lowered positions. Continued revisions needed to improve securing mechanism.

Prototype	Image	Comments
Version 7a		Experimental implementation of a 5-cell magnetic latch as a locking and stabilizing mechanism. Design abandoned because of potential concerns associated with magnet-sensitive indwelling patient devices (eg, pacemaker).
Version 7b		Use of a cam mechanism as an alternative locking and stabilizing mechanism. Design abandoned because of cost, complexity, and durability concerns of previous cam system.
Version 8		Development and incorporation of a custom-built spring-loaded latching mechanism for lateral attachment and improved surface securement. Continued revisions needed to improve use characteristics and user comfort.
Version 8		Selection of a commercial spring-loaded latching pin mechanism and horizontal stabilizer bar for final design specification. Additional attachment of a radiofrequency identification tag to allow wireless tracking of the device's location in the study area.



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The practice of emergency medicine/editorial

Design: A Neglected Modality for Improvement

Robert L. Wears, MD, PhD

"they used an iterative, rapid-prototyping design approach rather than… assuming they could come up with an ideal design… with the application of effort, skill, and logic."

Design opportunity

Design opportunity

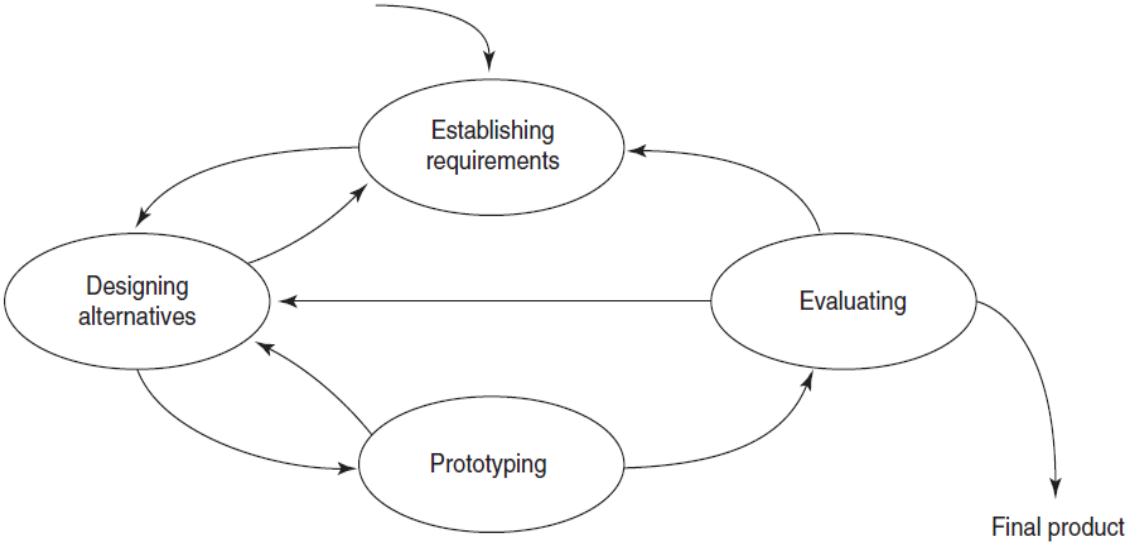
Slides relating to intervention have been removed.

Interaction Design Process

"Rapid Prototyping"

Constantly evolving design

Feedback at every stage

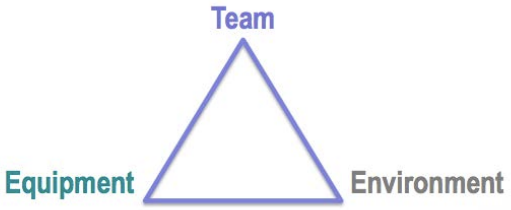


Benefits

- ***User-centered***
  - *Accurate*
  - *Accepted*
- ***Practical***
  - *Time*
  - *Cost*

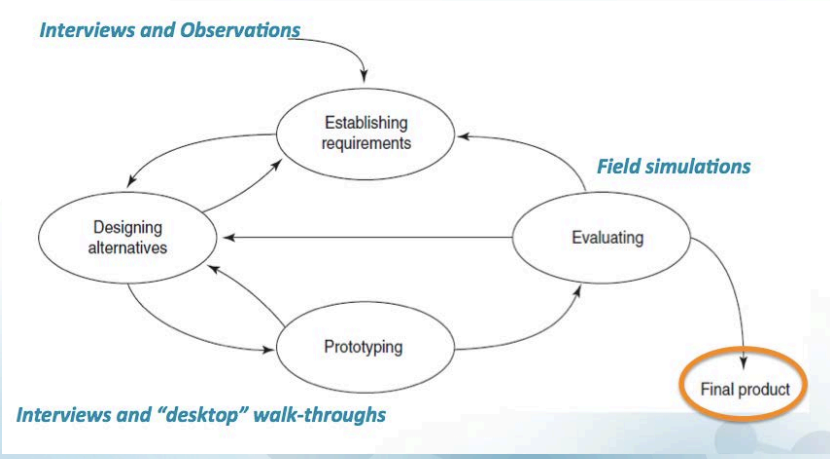
Take home messages

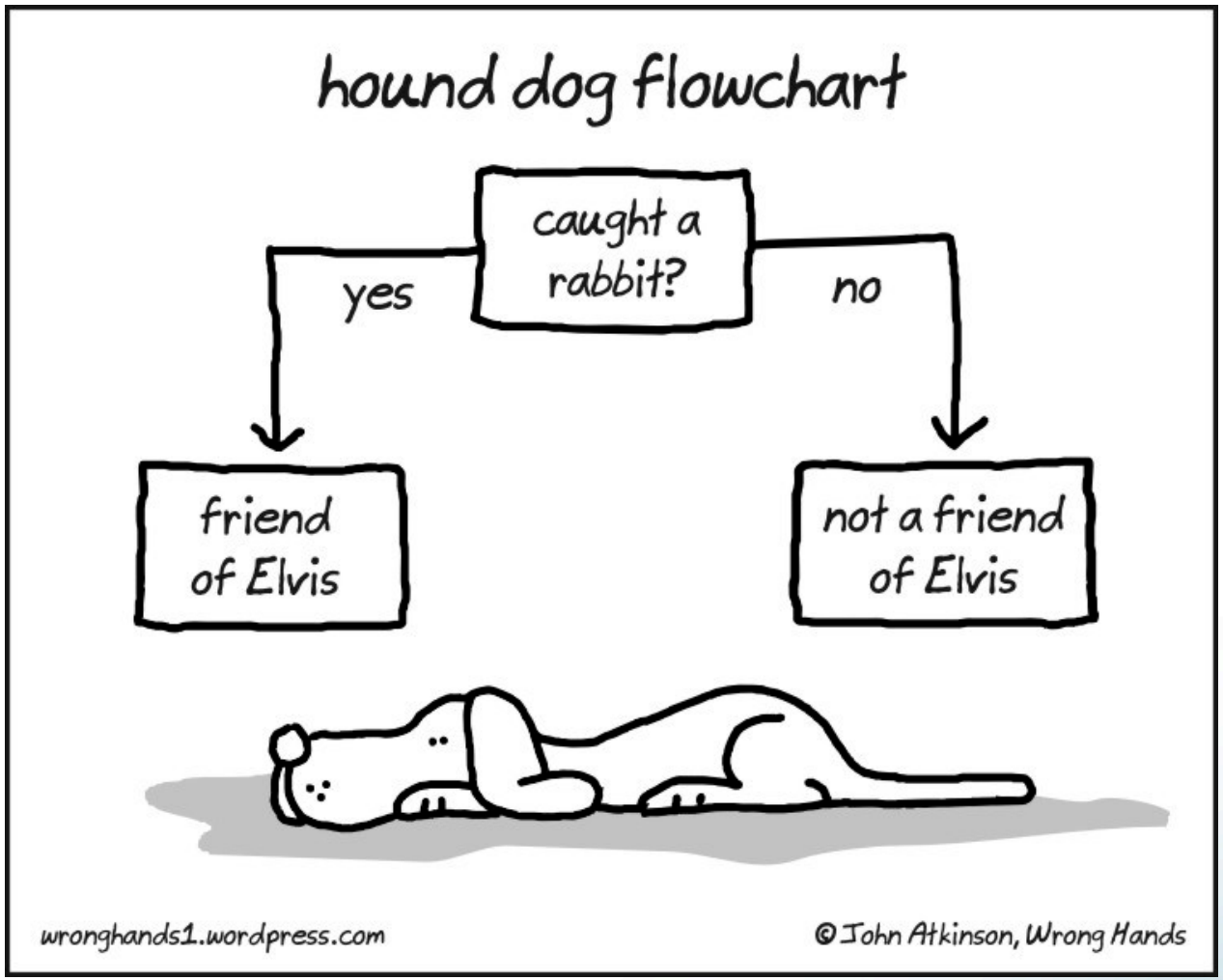
1. *Teams don't function in isolation: their co-ordination is effected by their tools and environment*



2. *Cognitive aids are valuable, but only if they are well designed*

3. *Take a inter-disciplinary, user-centered design approach to cognitive aid development*




hound dog flowchart
caught a rabbit?
yes
no
friend of Elvis
not a friend of Elvis
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