Indication -based guideline for arterial blood gas analyses after cardiac surgery, and its impact on hospitals' economy and patients' outcome

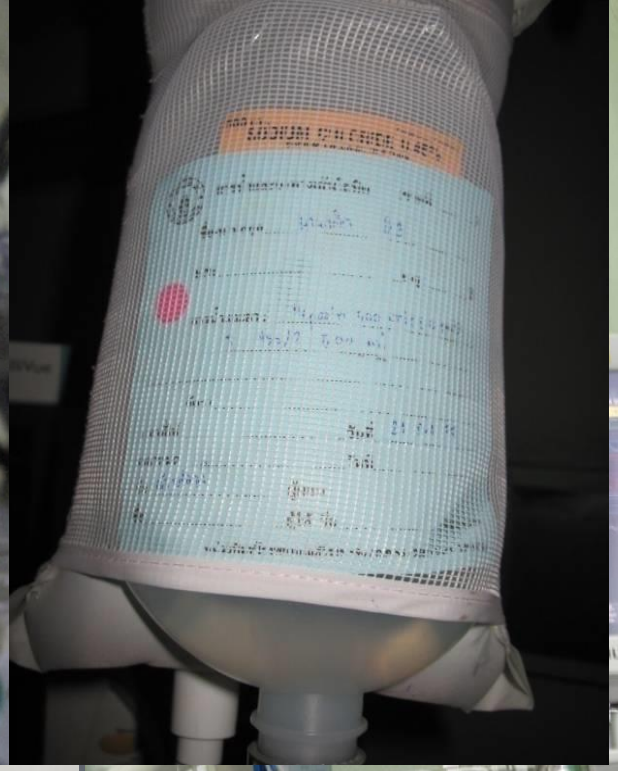
Pranee Tongsai

Research

Indication-based guideline for arterial blood gas analyses after cardiac surgery, and its impact on hospitals' economy and patients' outcome.

Pranee Tongsai, Sirilak Suksompong[1], Suntaraporn Nicrotha, Narisa Ajonsre, Wanchai Wongkornrat[2], Duangjai Oddgun[1], Benno von Bormann[1]


ARTERIAL




103
99
(197)
153
(195)
0


SINGLE USE ONLY TERUMO
LOT
31-08-2015
3241420

Rational and problems

- As a consequence of stereotype routine testing – every 4 hours until discharge – on our cardiac ICU in2013 about 27,000 US dollars have been spent exclusively for arterial blood gas (ABG) tests in adult cardiac patients.
- This routine is applied even in hemodynamic and respiratory stable patients. Additionally, ABG tests are performed after new adjustment of ventilator settings, decreasing oxygen saturation or significant hemodynamic changes, such as hyper-/hypotension and arrhythmia

Rational and problems

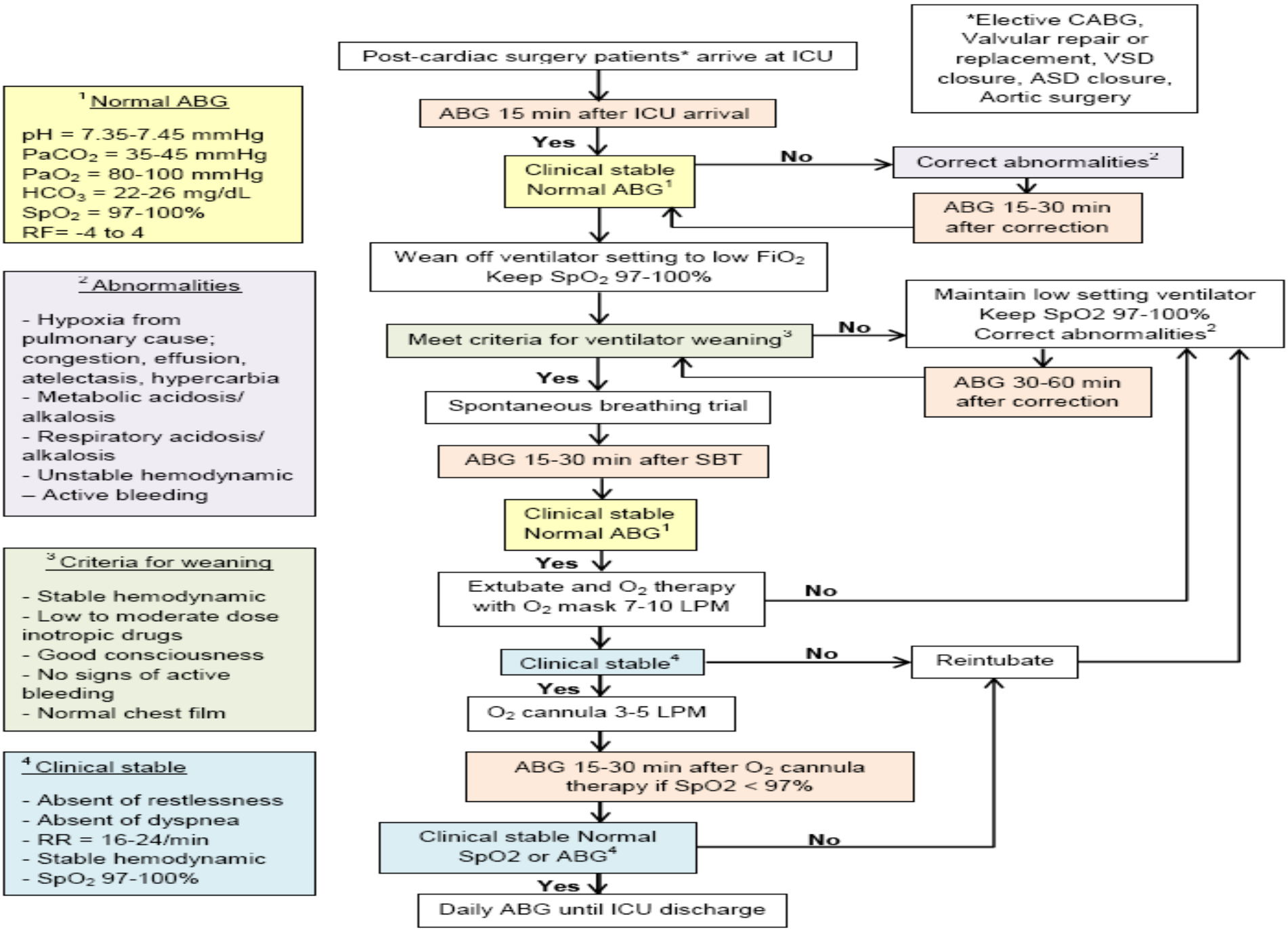
- In 2007, Melanson et al.demonstrated that 25.7% of ABG tests in a large tertiary care hospital were without comprehensible indication.
- Merlani et al.(2001)developed a guideline for ABG testing in non cardiac surgical patients leading to a significant decrease of its application without any impact on patients' outcome.
- To our knowledge, there is no published guideline for ABG testing in postoperative cardio-surgical patients during their stay on intensive care unit.

Materials and Methods

Guideline development

A pilot version of the guideline was designed locally by cardiothoracic surgery unit consultant, surgeon ,anesthetist and senior nurse.

Guideline for Arterial Blood Gas requests for Post-cardiac surgery patients at ICU



Objectives

1.To evaluate the frequency of arterial blood gas analyses by comparing a conventional with a guideline-based schedule, and

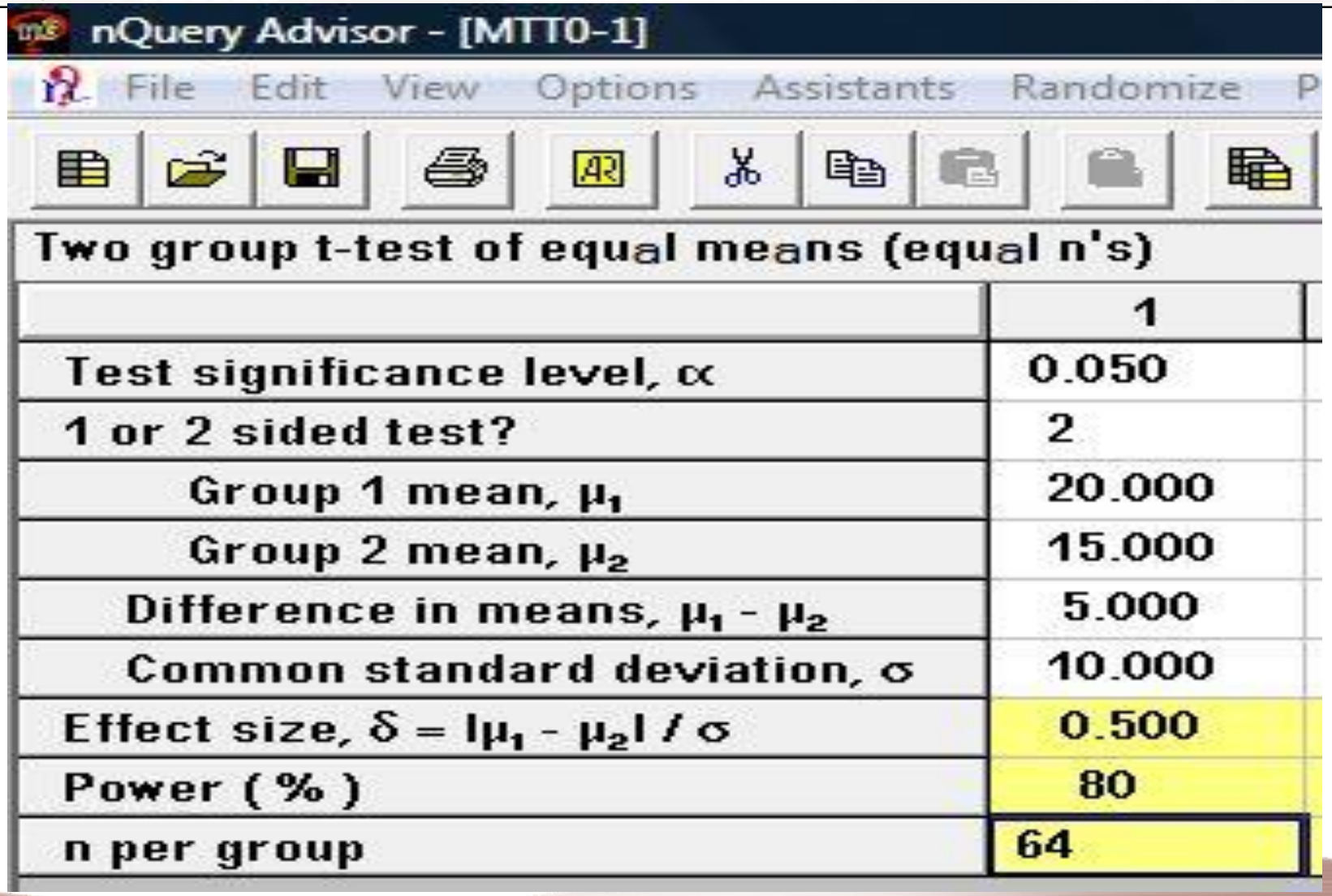
2. To investigate the influence of ABG testing on patients' outcome.

Materials and Methods

Sample size

For sample size calculation routine data of ICU have been used. It was known that the average number of ABG analyses per patient during the first three ICU-days is twenty. Assuming a 25% reduction by application of an indication based schedule, the required sample size was 70 patients in each group with a type I error of 0.05 and a power of 80%.

Materials and Methods



Two group t-test of equal means (equal n's)

	1
Test significance level, α	0.050
1 or 2 sided test?	2
Group 1 mean, μ_1	20.000
Group 2 mean, μ_2	15.000
Difference in means, $\mu_1 - \mu_2$	5.000
Common standard deviation, σ	10.000
Effect size, $\delta = \lvert\mu_1 - \mu_2\rvert / \sigma$	0.500
Power (%)	80
n per group	64

Materials and Methods

Inclusion criteria

*Patients who are undergoing elective cardiac surgery include: CABG ,Valvular heart ,ASD,VSD and aortic surgery.

* Aged over 18 years old.

*Agreed to participate in this study.

Exclusion criteria

*Post-operative shock

Materials and Methods

Quasi-experimental study in a University hospital After institutional review board approval,post operative patients on cardiac intensive care unit. Seventy randomly selected patients treated during January – September 2013 served as control (GroupC); their data were recorded retrospectively. Another seventy patients, guideline group (Group G),were prospectively investigated after providing written informed consent during January -May 2015.

Case record form for request Guideline arterial Blood GAS

No...

1.ข้อมูลทั่วไปของผู้ป่วย

1. อายุ.....ปี (บริบูรณ์)
2. เพศ ☐ ชาย ☐ หญิง
3. Diagnosis.....
4. Operation.....
5. Operation time.....
6. Cardiopulmonary bypass time.....
7. Aortic cross clamp time.....
8. Length of Stay.....

2.จำนวนครั้งของการเจาะเลือดเพื่อติดตามผล Arterial Blood GAS

ครั้งที่	วัน/เดือน/ปี	เวลา	เหตุผล*** (ใส่เป็นตัวเลข)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			

*** เหตุผล (เลือกได้มากกว่า 1 ข้อ)
1. แรกรับจาก OR.
2. ปรับ ventilator setting
2.1 ปรับเพิ่มลดออกซิเจน
2.2 ปรับลด-เพิ่ม pressure support
2.3 ปรับลด-เพิ่ม RR
2.4 ปรับลด-เพิ่ม peep
2.5 ปรับ Mode CMV ,SIMV,CPAP
2.6 ไม่มีการเปลี่ยนแปลง ของ settings
3. หายใจผิดปกติ
4. มีความผิดปกติ ของ Metabolic
6 .Before Extubation
7. After Extubation
8. HCT ต่ำ
9. Follow-up on abnormal results
10. ไม่เชื่อค่า O2 sat ปลายนิ้ว
11. มีการเปลี่ยนแปลงของ Conscious
12. มี Cardiac arrhythmia
13. ติดตามค่า K+
14. เหตุผลอื่นๆ ระบุ.....

3. ภาวะแทรกซ้อน/อาการไม่พึงประสงค์

☐ Severe Metabolic acidosis
☐ Severe Metabolic alkalosis
☐ Severe respiratory alkalosis
☐ Severe respiratory acidosis
☐ Cardiac arrhythmia ☐ Re-intubation


Results

Table 1 Patients baseline characteristics and perioperative data.

	Group C (n = 70)	Group G (n = 70)	p-value
Age (year)			0.394
<60	28 (40)	33 (47.1)	
≥60	42 (60)	37 (52.9)	
Gender			0.236
male	34 (48.6)	41 (58.6)	
Type of operations			0.455
– CABG	27 (38.6)	29 (41.4)	
– CABG with valve repair	8 (11.4)	6 (8.6)	
– Valve replacement/repair	33 (47.1)	29 (41.4)	
– Closure of ASD with or without valve repair	2 (2.9)	6 (8.6)	
Perioperative periods			
Operation time (min)	233.16 ± 81.81	217.97 ± 72.77	0.248
Cardiopulmonary bypass time (min)	114.61± 49.69	110.47 ± 46.23	0.610
Aortic cross clamping time (min)	85.26 ± 46.05	75.74 ± 34.84	0.172
Ventilator time (hours)	14.02 ± 11.98	14.90 ± 10.47	0.643
Length of ICU stay (days)	1.84 ± 1.35	1.73 ± 1.44	0.629

Data presented as mean ± SD or number (%)

Abbreviation: CABG = coronary bypass graft surgery; ASD = atrial septal defect.

Table 2 Frequency and indication of arterial blood gas analyses.

Data presented as number or Median (Min, Max)

Timing and frequency of ABG test	Number or Median (Min, Max)		p-value
	Group C	Group G	
ICU arrival (N)	70	70	
• Once	70	69	0.316
• Twice	0	1	
Change of ventilator setting	2 (0 - 13)	1 (0 - 3)	< 0.001
total	189	64	
Prior to extubation			0.702
• Once	63	64	
• Twice	2	3	
• total	67	70	
Post-extubation			< 0.001
• Once	68	45	
Routine testing (4 hourly vs daily)	2 (0 - 24)	0 (0 - 9)	< 0.001
Total	244	55	
- Hypoxia (PaO_2 < 80 mmHg)			0.855
• Once	2	2	
• Twice	2	1	
• Thrice	1	0	
• Total	9	4	
- Metabolic event ($PaCO_2$ > 45 mmHg)	0 (0 - 7)	0 (0 - 2)	0.683
Total	18	10	
- Hypercarbia			0.063
• Once	7	1	
• Twice	1	1	
• Thrice	0 (0)	1	
• Total	9	6	
Total	8 (4 - 47)	4 (2 - 15)	< 0.001
	674	**324**	

Results

Median costs of ABG testing per patient during ICU stay were 40(20 – 235) and 20 (10 – 75) US$ in group C and group G, respectively.

Conclusion

The guideline applied in this study, though restrictive, had no influence on clinical outcome but led to a significant reduction of ABG tests, saving costs and reducing workload. Its permanent implementation on cardiac surgery intensive care units seems to be reasonable, and is recommended.

Group C

MONITORING NURSING RECORD, SIRIRAJ HOSPITAL

Name .... Age .... yrs. HN. .... AN. .... Ward ไอ.ซี.ยู. .... Bed 4

Date / Time	Type of Airway	Type / Mode	Pressure (cmH2O)	TV (ml)	Flow (L/min)	RR (b/min)	FiO_2	PEEP (cmH2O)	I:E	Inspire Time	PS (cmH2O)	* Type of Respiration / Slope	PIP cmH_2O / Trigger	Flow rate	RR/min	Cal TV/cc	MIN Vol/min	Exp TV / Na	K / O_2Sat	give / ET CO_2	Duration of Weaning Time	Time of ABG	pH	PO_2	PCO_2	HCO_3	BE	O_2Sat	REMARK ET tube No. 7.0 mark 20 cm
20 ... / 16.30	ET	Evita XL / CMV		450	Auto	12	1.0	5	1:3.2	1.2	-	0.2	2.0																Hct = 30%
16.30		———					0.6	———										142	3.96	Nacl		16.30	7.460	262	33	22.4	-1.8	100%	PRC 1U
17		" ———				10	0.4	———										142	3.76	Nacl		17.30	7.430	99	33	21.9	-2.4	98%	
20		SIMV	" ———								10							144	3.10	Nacl		21.30	7.390	176	37	22.4	-2.6	100%	Hct = 36%
23.30	ET	Evita XL / SIMV		450	Auto	10	0.4	5	1:4.0	1.2	10							145	3.8	Nacl		21/3/56 5.30	7.380	139	39.4	23.1	-2.9	98%	
21/3/56 7.30	ET	Evita XL / SIMV		450	Auto	10	0.4	5	1:4	1.2	10	0.9	2.0																
8				On O_2 T-piece 7 LPM								O_2 sat 100%						140	3.70	NO.K		9.45	7.400	136	43	22.0	-1.6	99%	
9				Extubate tube On O_2 mask 7 LPM (c ...)														140	3.7	NO.K		10.45	7.330	229	42	22.1	-3.8	100%	
11				On O_2 cannula 5 LPM														143	3.74	NO.K		14	7.393	115	39.2	23.3	-1.6	99.2%	
15.35				On O_2 cannula 5 LPM														142	3.5	NoKcl		17.00	7.330	141	49.0	24.3	-1.0	99.0%	
				" ——— "									O_2 Sat 99-100%					141	3.66	NoKcl		21.10	7.390	162.8	40.0	24.2	-0.8	99.0	Hct 32%
22.30				On O_2 cannula 5 LPM														135	3.89	BiCarb Soln		22/3/56 1.59	7.396	192.1	39.7	19.4	-5.9	99.1	
																		138	3.60	EKCl		5.59	7.411	149.4	34.7	21.5	-3.1	98.9	Hct = 31%
22 มี.ค. 56 9.45				On O_2 cannula 5 LPM														135	4.7	30 ml E		10.01	7.33	122	42	22.1	-3.8	98%	
11.10				On O_2 cannula 5 LPM																									

* หมายเหตุ A = Assist C = Control S = Spontaneous

หน่วยพิมพ์โรงพยาบาลศิริราช 431 / 30,000 แผ่น / ค.ก. 45 / 190 ก. (2 หน้า)

Page ....

Group G

MONITORING NURSING RECORD, SIRIRAJ HOSPITAL

Name .... Age .... yrs. HN. .... AN. .... Ward .... ICU .... Bed ... 3 ...

Date / Time	Type of Airway	Type / Mode	Pressure (cmH2O)	TV (ml)	Flow (L/min)	RR (b/min)	FiO_2	PEEP (cmH2O)	I:E	Inspire Time	PS (cmH2O)	* Type of Respiration (Setting)	PIP cmH2O	Flow rate	RR/min	Cal TV/kg	MIN Vol/min (Cr^{++})	Exh TV (Na^+)	O_2Sat (K^+)	ET CO_2 (K_gT)	Duration of Weaning Time	Time of ABG	pH	PO_2	PCO_2	HCO_3	BE	O_2Sat	REMARK (ET-tube no. 7.5, mask 12.0 cm [illegible])
23/6/52 17.40	ET	Bennett 7200 / CMV	-	700	45	12	1.0	3.3	-	-	-	0.5					3.6	129	3.81	Ne.440		17.49	7.342	421.9	91.1	20.9	-0.7	99.9%	Hct (ข้างบน) 38%
18 น.	ET	B 7200 / SIMV	-	500	45	12	0.4	3.3			10	1.0	(0.5785)				4.0	137	4.10	Ne.440		02.07	7.429	224.2	31.2	20.20	-4.2	99.47	PRC in OR = 300 ml Hct = 37%
24	ET	B7200 / SIMV		500	45	ND	0.4	3.2			10	1.0										24/6/52							
24/6/52 4		CPAP		-	45	-	0.0	3	—	—	10	0.5					5.0	133	5.30	Nma		5.43	7.404	178.3	30.6	20.4	-3.7	99.3	Hct 31.7 ↓ (CPAP)
9.35 น.	ET	B7200 / CPAP		-	45	-	0.4	3	—	—	10	1.0		(O_2-sat 100%)															(FC 2 V)
[illegible]		SIMV		500	45	6	0.4	3	—	—	6	1.0																	
12		SIMV		500	45	6	0.4	3.2	—	—	10	1.0																	
15.30	ET	B7200 / SIMV		500	45	6	0.4	3.2	-	-	10	1.0																	
20 น.	—	—	—	—	—	—	—	—	—	—	8	—		0.9875		0 [illegible] (100%)													Hct 33%
23 น.	ET	B7200 / SIMV		500	45	6	0.4	3.2			8	1.0					4.1	132	4.04			23.51	7.353	118.8	42.0	24.4	-0.6	99.84	
25/6/52 1		"		—	—	—	—	—	—	—	—	0.5					4.4	133	3.70			25/6/52 suction clear air way 5.25	7.433	159.1	38.1	24.5	0.6	99.1%	
8 น.	ET	B7200 / SIMV		500	45	6	0.4	3.2	-	-	8	0.5																	
11.35				T-piece O_2 flow 10 LPM (O_2 sat 100%)													4.8	133	4.94			13.06	7.416	374.5	39.3	19.6	-0.0	99.7%	Hct 35% [illegible]
15 น.				- Extubated on O_2 Mask [illegible] – (O_2 sat 100%)																									
17 น.				Cannula 5 L/m													4.4	135.0	3.63			21.50	7.[illegible]	154.8	40.9	27.2	2.7	99.4	

* [illegible] A = Assist C = Control S = Spontaneous

หน่วยพิมพ์โรงพยาบาลศิริราช 437 / 53,000 แผ่น / พ.ศ. 43 [illegible]

Lesson learn

- บุคลากรในหน่วยงานมองว่า สิ่งนั้นคือปัญหา
- มองปัญหาให้เป็นโอกาสพัฒนาและนำไปสู่การเปลี่ยนแปลง
- และสิ่งที่พัฒนานั้นจะยั่งยืนถ้าทุกคนมองเห็นประโยชน์และคุณค่าของผลการพัฒนาหรือการปรับเปลี่ยน