Mechanical Ventilators Availability Survey in Thai ICUs (ICU-RESOURCE I Study)

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Objective: *Mechanical ventilators (MV) have been progressing rapidly. New ventilator modes and supportive equipments have been developed. However; the MV status in Thai ICUs was not available. The objective of this report was to describe the MV supply and availability in Thai ICUs and review some important characteristics regarding of the availability of MV.*
Material and Method: *The ICU RESOURCE I study (Mechanical ventilator part) database was used in the present study. Hospital types, MV brands and models were recorded. Statistically significant differences between and among groups were defined as p-value<0.05.*
Results: *A total of 2,098 MVs were included in the present study. Of these, 448 electrically independent MVs (Bird's Mark) were noted (21.35%). The remainder of 1,650 (78.65%) MVs were electrically dependent MVs (eMV). About 90 percent of eMVs were from the following seven eMV brands including Benette, Hamilton, Event, Newport, CareFusion or Bird (volume type), Drager and Servo respectively. About half of them were from the two brands of Bennette and Hamilton. Recent advanced MVs including EvitaXL, Hamilton G5, Servo-I and Epi (NAVA) were more available in academic ICUs than in non-academic ICUs. The adult HFOV could be found only in academic ICUs in this survey.*
Conclusion: *Bird Mark ventilators were also a high proportion of the MVs in Thai ICUs. Bennette and Hamilton were the most highly available MV in this survey. Advanced MV models were more available in academic ICUs (Thai Clinical Trial Registry: TCTR-201200005).*

Keywords: *Thai ICUs, Mechanical ventilator, Supply, Non-conventional mode*

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Mechanical ventilators (MV) have been developing along with the worldwide growth of critical care medicine. The MV has been an important part of care in critically ill patients as a respiratory, hemodynamic and metabolic support. In the last decade, the leapfrogging of computer science has resulted in the rapid development of advanced MV models and their utilizations. Alterations of MVs have changed the MV control from open loop control into closed loop control[(1)]. Currently, more complexity of the MV control system has occurred and led to a hierarchy of ventilator control systems[(1)]. These MV developments results have contributed to greater patient comfort, more patient-ventilator synchrony, delicate breath adjustment, and less complications[(2,3)]. However, the status of MV supply in Thai ICUs has been unavailable. The objective of this study was to describe the MV situations and availability in Thai ICUs and review those important characteristics.

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Material and Method

The ICU RESOURCE I database MV portion was retrieved for analysis. The survey was performed between March and August 2012. Data record forms were distributed to all Thai regions. The MV was one part of the equipment survey in Thai ICUs. MV types and models were recorded for availability and their number in participating ICUs. Hospital types were divided into four groups depending on hospital size academic activity and government service as general, regional, academic or private hospitals. This survey was approved by the Ethics Committee, Chiang Mai University. The ICU RESOURCE I was registered in Thai Clinical Trial Registry (TCTR-201200005).

Data were entered into the online medical research tool (OMERET). Verification data was performed by research assistants. Unclear data were confirmed. STATA 11.0 (STATA Inc., College Station, TX) was used for statistical analysis. Categorized data were stated in percent and differences among groups were tested by Chi-2 or Fisher exact probability tests. Significant statistical difference was defined as p-value<0.05.

Results

Six months of data were collected in August 2012 with a total 155 ICUs from all Thai regions participating in the survey. A total of 2,098 MVs were included in this study. Of these, there were 448 (21.35%) electrically independent MVs or pneumatically powered ventilators (Bird Mark). A total of 1,650 (78.65%) MVs were electrically dependent MVs (eMV) with the distribution demonstrated in Fig. 1. Of these, 90 percent of the eMV were included in seven eMV brands including Bennette, Hamilton, Event, Newport, CareFusion or Bird (volume type), Drager and Servo. About half of them involved two brands consisting of Bennette and Hamilton (Fig. 1).

In all Thai ICUs availability in Table 1, the first four most commonly available eMV models were Bennette 840, Bennette 7200, Hamilton Galieo and Hamilton Raphael respectively. These had a median number of two to four machines in each ICU. These relationships were similar in the general and regional ICUs as well. In addition, private hospitals had more availability of both models of Newport E500 and E360. However, the four most common MVs in academic ICUs were Bennette 840, Drager Evita 4, Bennette 7200 and Servo-I, respectively with median number of 1-3.5 in range.

By brand aspects in Table 1, hospital types had tendency differences of MV availability types. Bennette was contained in all hospital type ICUs. While Drager and Servo had a higher availability in academic ICUs especially the Evita 4 and Servo-I (except Carina model) but the others (including Hamilton, Newport, CareFusion, Respronics, Graphnet, pneumovent, WDH and Bella) were more prevalent in non-academic ICUs. Recently advanced MVs including EvitaXL, Hamilton G5, Servo-I and Epi (NAVA) were more available in academic ICUs than non-academic ICUs. Adult HFOV could be found only in Academic ICUs. Among the small sized ventilators (Carina, ParaPac and LTV), Carina had higher availability than the others especially in regional and academic ICUs, respectively. Non-invasive MVs (NIV) were found only in general and academic ICUs in this survey.

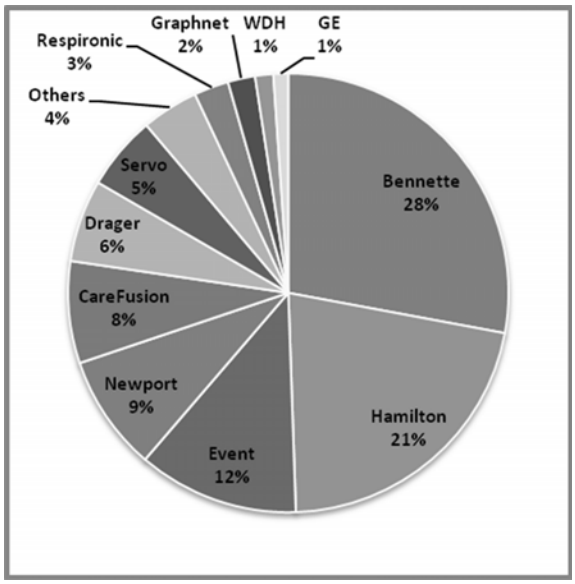

Fig. 1 Distribution of electrically dependent mechanical ventilators in this survey (Bird's Mark was excluded).
Note: Others included pediatric ventilators, transport ventilators, Bella Vista, Pneumovent, non-invasive ventilators and high frequency oscillatory ventilators; CareFusion included Bird volume

Discussion

This survey was a pioneer report on MVs in Thai ICUs. The selective criteria for procurement of MV in hospitals were different in each hospital. These included patient types and age, hospital types, physician familiarity, ventilator model requirements, post-purchase services and budgets. Thailand is a developing country and most of the service hospitals were government-based hospitals. With limitations of the annual government statement of expenditures, therefore, selection of MVs depended on the price and number of MV requirements within an obtainable budget. Because of its price and electrical independence or pneumatically driven MV, Bird's Mark was a simple MV that was most available in Thai hospitals. In our survey, it comprised 20.35 percent of all MVs in participating ICUs. Larger hospital and academic hospital ICUs trended toward significantly lower availability than smaller hospital ICUs (Table 1). This type MV was substituted by higher generation of eMVs in these ICUs. Table 2 summarized the commonly

Table 1. Common mechanical ventilator availability brands in Thai ICUs by hospital types

Ventilator [n (%)]	Model	All (n = 155)	General (n = 51)	Regional (n = 51)	Academic (n = 36)	Private (n = 17)	p-value
Bennette	840	71 (45.81)	24 (47.06)	19 (37.25)	21 (58.33)	7 (41.18)	0.27
	760	11 (7.10)	10 (19.61)	1 (1.96)	0 (0.00)	0 (0.00)	<0.01
	7200	55 (35.48)	27 (52.94)	12 (23.53)	10 (27.78)	6 (35.29)	0.04
Drager	EvitaXL	8 (5.16)	2 (3.92)	2 (3.92)	4 (11.11)	0 (0.00)	0.28
	Evita4	15 (9.68)	1 (1.96)	3 (5.88)	11 (30.56)	0 (0.00)	<0.01
	Evita2	1 (0.65)	0 (0.00)	0 (0.00)	1 (2.78)	0 (0.00)	0.34
	Savina	8 (5.16)	3 (5.88)	2 (3.92)	3 (8.33)	0 (0.00)	0.60
	Carina	23 (14.84)	2 (3.92)	13 (25.49)	7 (19.44)	1 (5.88)	0.01
Hamilton	Galieo	44 (28.39)	20 (39.22)	11 (21.57)	6 (16.67)	7 (41.18)	0.05
	G5	14 (9.03)	7 (13.73)	0 (0.00)	6 (16.67)	1 (5.88)	0.02
	C2	23 (14.84)	7 (13.73)	12 (23.53)	2 (5.56)	2 (11.76)	0.13
	C1	4 (2.58)	1 (1.96)	1 (1.96)	2 (5.56)	0 (0.00)	0.60
	Raphael	38 (24.52)	14 (27.45)	19 (37.25)	3 (8.33)	2 (11.76)	0.01
	Amadeus	1 (0.65)	0 (0.00)	1 (1.96)	0 (0.00)	0 (0.00)	0.56
Newport	E500	16 (10.32)	7 (13.73)	5 (9.80)	1 (2.78)	3 (17.65)	0.28
	E360	14 (9.03)	7 (13.73)	2 (3.92)	1 (2.78)	4 (23.53)	0.03
CareFusion	Avea	16 (10.32)	11 (21.57)	2 (3.92)	3 (8.33)	0 (0.00)	0.01
(Bird)	Vela	26 (16.77)	13 (25.49)	9 (17.65)	3 (8.33)	1 (5.88)	0.10
	Mark	43 (27.74)	19 (37.25)	11 (21.57)	6 (16.67)	7 (41.18)	0.07
	Others[1]	8 (5.16)	1 (2.78)	4 (7.84)	1 (5.88)	2 (3.92)	0.72
Servo	S	12 (7.74)	3 (5.88)	4 (7.84)	3 (8.33)	2 (11.76)	0.87
	I	22 (14.19)	4 (7.84)	6 (11.76)	10 (27.78)	2 (11.76)	0.06
	Edi (NAVA)	2 (1.29)	0 (0.00)	1 (1.96)	1 (2.78)	0 (0.00)	0.64
Event	Inspiration	28 (18.06)	18 (35.29)	8 (15.69)	1 (2.78)	1 (5.88)	0.00
	eVolution	10 (6.45)	4 (7.84)	4 (7.84)	2 (5.56)	0 (0.00)	0.67
Respironics	Esprit	18 (11.61)	8 (15.69)	5 (9.80)	5 (13.89)	0 (0.00)	0.33
	Engstrome	7 (4.52)	3 (5.88)	1 (1.96)	3 (8.33)	0 (0.00)	0.39
Graphnet		13 (8.39)	3 (5.88)	9 (17.65)	0 (0.00)	1 (5.88)	0.02
Pneumovent		2 (1.29)	1 (1.96)	1 (1.96)	0 (0.00)	0 (0.00)	1.00
Bella	Vista	1 (0.65)	0 (0.00)	1 (1.96)	0 (0.00)	0 (0.00)	0.56
WDH	1A	1 (0.65)	0 (0.00)	0 (0.00)	0 (0.00)	1 (5.88)	0.04
HFOV (Adult)	(see notes)[2]	4 (2.58)	0 (0.00)	0 (0.00)	1 (2.78)	1 (5.88)	0.19
Non-invasive	(see notes)[3]	2 (1.29)	1 (2.78)	0 (0.00)	1 (5.88)	0 (0.00)	0.19
Pediatrics(others)	(see notes)[4]	15 (9.68)	3 (5.88)	8 (15.69)	0 (0.00)	4 (23.53)	0.02
Transport	(see notes)[5]	2 (1.29)	1 (1.96)	0 (0.00)	0 (0.00)	1 (5.88)	0.25

[1] Including bird volume model VIP, 6400ST, 8400ST; [2] High frequency oscillator ventilator (Adult) e.g. sensormedics; [3] Non-invasive ventilator e.g. BIPAP-Vision; [4] Pediatric mechanical ventilators including bear (model cub 750, cub 2001, VIP, sechrist millennium, pediatric HFOV); [5] Transport ventilator including ParaPac and LTV

used eMVs and their properties. Of these, for the market leader, about half of the MVs were divided between Bennete and Hamilton with a nearly comparable number. These might be explained by pioneering in the market more than three decades of Bennete MVs. For Hamilton, higher market sharing might be explained by their advanced mode such as ASV mode and their new developed options as well as post market service in our country. For the second level of market sharing, Event, Newport and CareFusion (including Bird's volume) were about ten percent each. For the third level, Drager and Servo had approximately five percent each. The remaining ten percent were covered by Respironic, Graphnet, WDH, GE and others (Fig. 1).

Recent non-conventional ventilator modes including proportional assist ventilation (PAV), neutrally adjusted ventilator assist (NAVA) and adaptive pressure ventilation (APV) were developed for improving patient ventilator asynchrony and user convenience[4,5]. In the present study, the authors found

Table. 2 Summarized some common used mechanical ventilator features and graphics in Thai ICUs (in addition to conventional modes)[1]

Ventilators	Model	Non-conventional modes	Graphic[2] (Number)[3]	Lung mechanic (option)	Dominant features	Prices[4]
Bennette	840	APRV, VS, PAV+, NIV, NEO	Time(2), Loop(1)	C,R, VC, NIF, P0.1	Smart rise time and fast response time, active exhalation valve, TC, LC,	0.8-1.0 M
	760	NA	NA	NA	NA	NA
	7200	NA	Time(1)	NA	NA	NA
Drager	Evita2 Dura	Same as Evita4	Time(2), Loop(2)	C, R	Open breathing concept, valve response time <5 ms	NA
	Evita4	ILV, NIV, Neoflow	Time(2), Loop(2)	C,R, NIF, P0.1, RSB	Same as Evita2	0.8-1.2 M
	EvitaXL	ILV, NIV, Neoflow, SmartCare	Time(3), Loop(2), low flow PV loop; $etCO_2$	Same as Evita4	Same as Evita2, Autoflow, CO_2 Measurement, SmartCare, Low flow PV loop, VCO_2, TC	1.0-1.5 M
	Savina	NIV	Time(3), Loop(2)	C, R, ($etCO_2$)	Same as Evita2, Autoflow, Max.flow 250 LPM	0.6-0.9 M
	Carina	NIV	Time(2)	C, R	Auto-Adapt, Syncplus	0.4-0.5 M
Hamilton	Amadeus	NA	NA	NA	NA	NA
	Raphael	ASV, APRV, DuoPAP, NIV, NIV-ST	Time(1), Loop(1)	C, R, AutoPEEP, RCexp	Lung mechanics, TRC	0.5-0.7 M
	C1	Same as Raphael	Time(2)	Same as Raphael, P0.1, RSB, WOB	Lung mechanics, TRC, IntelliTrig for NIV	0.6-0.8 M
	C2	Same as Raphael, nCPAP-PS	Time(2), Loop(1)	Same as C1	Same as C1	0.8-1.0 M
	Galieo	Same as Raphael, APV	Time(3), Loop(1)	Same as C1, PV tool	Same as C1	0.9-1.2 M
	G5	Same as Galileo	Time(8), Loop(4)	Same as Galieo	Same as C1, IntelliCuff	1.2-1.5 M

[1] Conventional modes including VC-CMV, PCV, SIMV and PSV; [2] Graphics were divided into two parts "Time" including pressure time, volume time curve, flow time curve; and "Loop" including pressure-volume loop and flow-volume loop; [3] Number of simultaneous demonstration of graphic(s); [4] Estimation price in million baht which was surveyed at May 2013 (price differences depended on their options).

AET = automatic expiratory threshold; AM = automode; APRV = airway pressure release ventilation; APV = adaptive pressure ventilation; ARC = airway resistance compensation; ASR = automatic slope rising; ASV = adaptive supportive ventilation; AutoPEEP(eso) = auto-positive end expiratory pressure (esophageal pressure); Bi-Level = bi-level pressure; BPRV = biphasic pressure release ventilation; C = compliance; Cchest = chest wall compliance; CPAP = continuous positive airway pressure; C20/C = compliance ratio; Edi = electrical activity of diaphragm; DuoPAP = duo-positive airway pressure; E = elastance; $etCO_2$ = end tidal carbon dioxide; FRC = functional residual capacity; HBO = hyperbaric oxygenation; HFOV = high frequency oscillation ventilation; ILV = independent lung ventilation; LC = leak compensation; NA = not available; NAVA = neutrally adjusted ventilator assist; nCPAP(-PS) = nasal continuous positive airway pressure (with pressure support) for infant; NEO = neonatal ventilation (start 2-5 ml); MAP = mean airway pressure; MRI = MRI compatible; NIF = negative inspiratory force; NIV = non-invasive ventilation; NIV-ST = NIV with spontaneous time mode for apnea backup; OLT = open lung tool; PAV+ = proportional assisted ventilation plus; Peso = esophageal pressure; PFC = pressure/flow cycle; Pflex = reflection pressure (slow flow); PMV = pressure/machine volume; PRVC = pressure regulated volume control; PSV-VL = pressure support ventilation-volume limit; PTP = Pressure time product; PV manual = manual pressure volume loop; P/VG = pressure/volume guarantee; P/VL = pressure/volume limit; PV tool = pressure volume tool; R = resistance; REE = resting energy expenditure; RCexp = respirtory system time constant of expiratory; RSB = rapid shallow breathing index; SBT = spontaneous breathing trial; SI = stress index; SmartCare = open breathing concept automatic weaning; SPAP = synchronize positive airway pressure; TC = tube compensation; TCPL = time cycle pressure limit; Tcon = time constant; TRC = tube resistance compensation; VC = vital capacity; VCO_2 = carbon dioxide production; VDF = volume demand flow; VO_2 = oxygen consumption; VS = volume support; VTPC(S) = volume target pressure control (support); WOB = work of breathing

Table. 2 cont.

Ventilators	Model	Non-conventional modes	Graphic[2] (Number)[3]	Lung mechanic (option)	Dominant features	Prices[4]
Newport	E500	VTPC(S), BPRV, NIV	Time(3), Loop(2)	C, R, RSB, PVmaneuver	LC, ASR, AET, VTPC, BPRV	1.0-1.2 M
	E360	Same as E500	Time(3), Loop(2)	Same as E500, P0.1,NIF	Same as E500, Tcon	0.8-0.9M
CareFusion	Avea	TCPL, P/VG, P/VL, PMV, PFC, PSV-VL, VDF	Time(3), Loop(2), etCO2, Peso	C, R, Pflex, C20/C, WOB, AutoPEEPeso, Cchest	All age groups, TC, Peso	0.8-1.4M
	Vela	PMV, PFC	Time(3), Loop(2)	C, R	-	0.5-0.8 M
Servo	S	Bivent(APRV), PRVC, NIV	Time(3), Loop(2)	C, R, WOB, P0.1, E	Ultrasonic flow sensor	1.0-1.2 M
	I	Same as Servo-S, VS, nCPAP	Time(3-4), Loop(2)	C, R, E, $etCO_2$, SI, RSB, P0.1, OLT	Same as Servo S, HBO, MRI, Heliox, AM	1.2-2.5 M
	Edi(NAVA)	Same as Servo I, NAVA	Same as Servo I	Same as Servo I, Edi wave	Same as Servo I, patient synchrony	1.8-2.5 M
Event	Inspiration	PRVC, SPAP	Time(2), Loop(2)	C, R, AutoPEEP, RSB	AM	0.8-0.9 M
	eVolution	Same as Inspiration LS	Time(3), Loop(2)	Same as Inspiration, C20/C, WOB, P0.1	AM	0.6-0.7 M
Respironics	Esprit	NIV	Time(2)	C,R, AutoPEEP	Auto Trak™, rapid response time	0.8-0.9 M
	V200	NIV	Time(3), Loop(2)	C,R, VC, P0.1, MIP, AutoPEEP	Same as Esprit, Flow Trak™, volumetric CO_2	0.8-1.5 M
GE	Versamed	PRVC ,Bi-Level(APRV)	Time(3) ,Loop(2)	C, R, RSB, MAP	Adaptive flow- I-time, Easy Exhale, MRI	0.7-0.9 M
	Engstrom	PCV-VG, Bi-level, NIV, NEO	Time(3) ,Loop(2), $etCO_2$	C, R, RSB, AutoPEEP, P0.1, NIF, VC, FRC, PV tool	VG, VO_2, VCO_2, REE, ARC, LC, SBT, SpiroDynamics	0.8-1.6 M

[1] Conventional modes including VC-CMV, PCV, SIMV and PSV; [2] Graphics were divided into two parts “Time” including pressure time, volume time curve, flow time curve; and “Loop” including pressure-volume loop and flow-volume loop; [3] Number of simultaneous demonstration of graphic(s); [4] Estimation price in million baht which was surveyed at May 2013 (price differences depended on their options).

AET = automatic expiratory threshold; AM = automode; APRV = airway pressure release ventilation; APV = adaptive pressure ventilation; ARC = airway resistance compensation; ASR = automatic slope rising; ASV = adaptive supportive ventilation; AutoPEEP(eso) = auto-positive end expiratory pressure (esophageal pressure); Bi-Level = bi-level pressure; BPRV = biphasic pressure release ventilation; C = compliance; Cchest = chest wall compliance; CPAP = continuous positive airway pressure; C20/C = compliance ratio; Edi = electrical activity of diaphragm; DuoPAP = duo-positive airway pressure; E = elastance; $etCO_2$ = end tidal carbon dioxide; FRC = functional residual capacity; HBO = hyperbaric oxygenation; HFOV = high frequency oscillation ventilation; ILV = independent lung ventilation; LC = leak compensation; NA = not available; NAVA = neutrally adjusted ventilator assist; nCPAP(-PS) = nasal continuous positive airway pressure (with pressure support) for infant; NEO = neonatal ventilation (start 2-5 ml); MAP = mean airway pressure; MRI = MRI compatible; NIF = negative inspiratory force; NIV = non-invasive ventilation; NIV-ST = NIV with spontaneous time mode for apnea backup; OLT = open lung tool; PAV+ = proportional assisted ventilation plus; Peso = esophageal pressure; PFC = pressure/flow cycle; Pflex = reflection pressure (slow flow); PMV = pressure/machine volume; PRVC = pressure regulated volume control; PSV-VL = pressure support ventilation-volume limit; PTP = Pressure time product; PV manual = manual pressure volume loop; P/VG = pressure/volume guarantee; P/VL = pressure/volume limit; PV tool = pressure volume tool; R = resistance; REE = resting energy expenditure; RCexp = respirtory system time constant of expiratory; RSB = rapid shallow breathing index; SBT = spontaneous breathing trial; SI = stress index; SmartCare = open breathing concept automatic weaning; SPAP = synchronize positive airway pressure; TC = tube compensation; TCPL = time cycle pressure limit; Tcon = time constant; TRC = tube resistance compensation; VC = vital capacity; VCO_2 = carbon dioxide production; VDF = volume demand flow; VO_2 = oxygen consumption; VS = volume support; VTPC(S) = volume target pressure control (support); WOB = work of breathing

that these MV modes were more available in academic ICUs or large hospital ICUs. NAVA was found only in academic ICUs. This might be explained by the expensive esophageal catheter which the NAVA requires.

The strength of the present study was the largest survey available of ventilator supply in Thai ICUs. However, there were some limitations in this study. Firstly, each MV had more than one option in each model. Detailing of MV option was not recorded. Therefore, although the MV model was the same in different ICU types, their options might be distinct. Secondly, most participating ICUs were located in government hospitals. MVs market sharing might be distorted if hospital proportion had been altered. Thirdly, daily utility of MV was not recorded. MV availability and number could not exhibit equipment utility. Fourthly, non-invasive MVs number in the survey might be lower than in reality. These might be confounded by non-invasive MV options in invasive MV and selection bias in counting of MV types were not random in all regions. Finally, the authors could not conclude and demonstrate all MV brands in our country because of their enormous variation on types, models and options. These included in pediatric MV, transport MV and HFOV.

Conclusion

Bird's Mark also had a high proportion of MV in Thai ICUs. Bennette and Hamilton were the most highly available supply of MVs in this survey. Advanced MV modes tended to have higher availability in academic ICUs.

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Potential conflicts of interest

None.

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การสำรวจเครื่องช่วยหายใจที่มีใช้ในหอผู้ป่วยหนักในประเทศไทย (ICU RESOURCE I study)

กวีศักดิ์ จิตตวัฒนรัตน์, ทนันชัย บุญบูรพงศ์, รัฐภูมิ ชามพูนุช, กลุ่มวิจัยสมาคมเวชบำบัดวิกฤตแห่งประเทศไทย

วัตถุประสงค์: การพัฒนาการของเครื่องช่วยหายใจกำลังดำเนินไปข้างหน้าอย่างรวดเร็ว มีการพัฒนาการช่วยแบบใหม่ๆ รวมถึงอุปกรณ์เสริมต่างๆ อย่างไรก็ตามนับตั้งแต่ที่มีการใช้เครื่องช่วยหายใจในประเทศไทย ยังไม่เคยมีการศึกษาสถานการณ์การใช้เครื่องช่วยหายใจในหอผู้ป่วยหนัก วัตถุประสงค์ของการศึกษานี้เพื่อศึกษา ข้อมูลเกี่ยวกับเครื่องช่วยหายใจที่มีใช้ในหอผู้ป่วยหนักในประเทศไทยและทบทวนลักษณะสำคัญบางอย่างของเครื่องช่วยหายใจเหล่านั้น

วัสดุและวิธีการ: ข้อมูลที่ใช้ในการศึกษาได้จาก ICU RESOURCE I ในส่วนเครื่องช่วยหายใจ โดยเก็บตัวแปรชนิดของโรงพยาบาล เครื่องช่วยหายใจทั้งชนิดและรุ่นรวมถึงจำนวนของเครื่องดังกล่าว ความแตกต่างอย่างมีนัยสำคัญทางสถิติเมื่อค่า $p<0.05$

ผลการศึกษา: เครื่องช่วยหายใจจำนวน 2,098 เครื่องช่วยหายใจได้นำมาใช้ในการศึกษานี้ ในจำนวนดังกล่าวเครื่องช่วยหายใจที่ไม่จำเป็นต้องใช้ไฟฟ้าเป็นตัวขับเคลื่อน (Bird's Mark) พบมีจำนวน 448 ตัว (ร้อยละ 21.35) จำนวนที่เหลือ 1,650 (ร้อยละ 78.65) เป็นเครื่องช่วยหายใจที่ต้องแรงไฟฟ้าเป็นตัวขับเคลื่อน ประมาณร้อยละ 90 ของเครื่องช่วยหายใจพบในเครื่องหมายการค้า Benette, Hamilton, Event, Newport, CareFusion หรือ Bird (volume type), Drager และ Servo ตามลำดับ ประมาณครึ่งหนึ่งอยู่ใน 2 เครื่องหมายการค้าของ Bennette และ Hamilton สำหรับเครื่องช่วยหายใจที่นำสมัย เช่น EvitaXL, Hamilton G5, Servo-I และ Epi(NAVA) มีแนวโน้มที่จะสามารถหาได้ในไอซียูที่เป็นสถาบันฝึกอบรมมากกว่าไอซียูที่ไม่ใช่สถาบันฝึกอบรม สำหรับเครื่องช่วยหายใจแบบ HFOV ในผู้ใหญ่พบเฉพาะในไอซียูที่เป็นสถาบันฝึกอบรมเท่านั้นในการสำรวจครั้งนี้

สรุป: Bird's mark ยังเป็นเครื่องช่วยหายใจที่พบในสัดส่วนที่สูงในไอซียูไทย Bennette และ Hamilton เป็นเครื่องช่วยหายใจที่พบได้มากและมีการใช้สูงในการสำรวจครั้งนี้ เครื่องช่วยหายใจแบบทันสมัยมีแนวโน้มที่จะพบในไอซียูที่เป็นสถาบันฝึกอบรมสูงกว่า