Characters of Physician and Nurse Staffing in Thai Intensive Care Units (ICU-RESOURCE I Study)

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Objective: *There have been no data available on physicians and nurses who are vital human resources in Thailand. The objective of this study is to describe these characteristics as well as their working patterns in Thai ICUs.*
Material and Method: *Data were retrieved from the ICU RESOURCE I study. Physician and nurse characteristics, working patterns and workloads in participating ICUs were recorded. After hour consultations, nurse staff years of experience, nurse specialist training and patient to bedside nurse ratios (PNR) were collected.*
Results: *One hundred and fifty-five hospitals are included in this study. Intensivists are available in 53 hospitals with a median of 0-1 intensivist per unit. Most intensivists are working in academic ICUs. The two specialties most involved in surgical ICUs were in critical care (34.1%) and surgical recovery (47.7%). Almost all pediatric ICUs were covered by pediatricians and only a quarter of them had been staffed with critical care pediatricians (28.6%). Less than 30 percent of Thai ICUs are covered by intensivists. About 42.3% of Thai ICUs have no night shift physician and the units contact the attending physicians directly. Experienced (more than 5 years) nurses staffing ICUs are at 62.5 percent. A total of 85.2% of the ICUs have certificated critical care nurses. Only 23.2% of all ICUs have an advance practice nurse (APN). The median PNR was 2:1 with an exception in academic ICUs.*
Conclusion: *Intensivists continue to be only scarcely available in Thai ICUs. Nurse workloads in non-academic ICUs were higher than those in academic ICUs. Specialty training for certified critical care nurses is in place for only one-third of the total number of ICU nurses. APNs are available in 25% of participating ICUs (Thai Clinical Trial Registry: TCTR-201200005).*

Keywords: *Intensivist, Critical care physician, Critical care nurse, Nurse to patient ratio, Advance practice nurse*

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The two vital staff members in Thai intensive care units (ICUs) designated to provide care are physicians and nurses. Evidence demonstrates that ICU staffing may help determine patient care outcomes[1,2]. Although intensivist and nurse training have been established for more than a decade in Thailand, there is no data available demonstrating the status of both in Thai ICUs. The status of physician and nurse staffing could be added to input data for human resource allocation in the health care system. Therefore, the objective of this study is to describe the physician and nurse characteristics as well as their working patterns in Thai ICUs.

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Material and Method

The ICU RESOURCE I database was used for the present study. The primary outcomes of the present study are focused on physician and nurse resources in participating ICUs. The type of ICU, hospital type, physicians' specialties, nurses' backgrounds, burden of work and work patterns were collected. Hospital types are defined in the report of cardiopulmonary monitoring as previously done by our study group are as follows: general, regional, academic and private hospitals. The Ethics Committee of the Faculty of Medicine, Chiang Mai University, approved this study which is registered in the Thai Clinical Trial Registry data base reference number; TCTR-201200005.

ICU types are categorized by specialties. These include: medical, surgical, mixed and pediatric ICUs. Physicians working in the ICUs were specialized. They are intensivists, internists, anesthesiologists and pediatricians. After hour consultation was divided by

the patterns of responsibility in the ICUs.

Nurse staffing features are categorized by years of experience, formal critical care nurse training courses and certifications. A certified nurse is defined as a nurse who has attended and completed a formal Critical Care Nurse Training Course from an accredited nursing faculty. Advance practice nurse (APN) is defined as a nurse who has finished a higher level of training and passed a certification examination as well as having received a diploma from the Nursing Council of Thailand. A nursing shift in Thailand is usually separated into the three periods: morning, evening and night shift.

Nurse workload in this study is reported in terms of the patient to nurse ratio (PNR), this ratio is calculated by dividing the number of patient beds by the number of registered nurses (RN) [PNR = number of patient beds/number of registered nurses].

Continuous data with parametric distribution are reported as mean $\pm$ standard deviation (SD). Non-parametric distribution is expressed as a median and interquartile range (IQR). To determine the differences between groups ANOVA and the Kruskal-Wallis equality of populations rank test are utilized. Categorical data are reported in percentages and the Chi-square test is used for detection of the differences. Statistical differences are defined as $p<0.05$.

Results

Data were collected from 155 ICUs over a six month period. Almost all of the private hospitals' ICUs are mixed ICUs (88.2%). More specialized ICUs were established in academic, regional and general hospitals (Table 1).

As seen in Table 1, critical care physicians are available in 53 hospitals with median number 0-1 per unit. Only intensivists and internists are available in medical ICUs. However, most of the intensivists worked in academic ICUs. All sub-specialties including: intensivists, internists, anesthesiologists, surgeons and pediatricians work in both surgical and mixed ICUs. The specialties most involved in surgical ICUs are in critical care (34.1%) and surgical (47.7%). However, surgeons have shown a more important role in general and regional ICUs than in academic ICUs. Internists, surgeons, and anesthesiologists are the first three specialties which had a crucial role in mixed ICUs (Table 1). Almost all pediatric ICUs are covered by pediatricians and only a quarter of them staff critical care pediatricians (28.6%).

Regarding after hour consultation, as shown in Table 2, less than 30 percent of Thai ICUs are covered by intensivists. This is especially of note in general and regional hospitals. Academic ICUs are covered by intensivists more than fifty percent of the time. However, about 42.3% of Thai ICUs have no night shift doctors and the individual patients' attending doctors (host doctor) are consulted whenever clinical problems occur.

Nursing staff experience in the ICUs is reported in Table 3. Experienced nurses (more than 5 years of experience) staffed in ICUs are at 62.5 percent of the total number of the nursing staff. This proportion decreases in academic and private ICUs with a significant difference of $p = 0.02$. The position of the nursing staff in both academic and private hospitals are provided by nurses whose average experience is only three to five years and the differences are statistically significant at $p = 0.03$. Regarding specialty training, 85.2% of the ICUs have certified critical care nurses. The proportions are higher in general and academic hospitals' ICUs and are lower in the private hospitals' ICUs. However, only 23.2% of all ICUs have an APN. The availability of APNs in government hospital ICUs are higher than in private hospital ICUs, but there are no significant differences.

The patient to nurse ratio (PNR) is significantly lower in academic hospitals for all work shifts particularly in surgical ICUs (Table 4). Most of participating ICUs have a median PNR of two to one with an exception in academic hospital ICUs. The trends of PNR are higher in surgical ICUs in general hospitals (2.1-2.2:1) and pediatric ICUs in regional hospitals (2-2.7:1).

Discussion

In the US, more than 20% of hospitals' budgets and resources are expended and consumed in the intensive care unit[3]. The best practical models for critical care physicians', intensivists' and critical care nurses' practices have been proposed[3]. Meta-analysis by Pronovost et al demonstrates that high intensity staffing was associated with lower ICU and hospital mortality[1]. Additionally, the ICU management pattern may have an impact on patient outcomes[4]. The critical care physician is a new branch of sub-specialty, which has had formal training in Thailand beginning in the year 2000. Despite its importance, there are few intensivists available in Thai ICUs. This is seen predominantly in mixed ICUs in general and private hospitals' ICUs. Contrarily, a higher availability of intensivists is found in the ICUs in regional and

Table 1. Physician specialist involved in Thai ICUs categorized by hospital and ICU types

Physician characteristics	All (n = 155)	General (n = 51)	Regional (n = 51)	Academic (n = 36)	Private (n = 17)	p-value
Medical ICU	(n = 42)	(n = 8)	(n = 19)	(n = 15)	(n = 0)	
Critical care (%)	22 (52.4)	1 (12.5)	9 (47.4)	12 (80.0)	NA	<0.01
Median (IQR)	1 (1)	0 (0)	0 (1)	1 (5)	NA	<0.01
Internal medicine (%)	24 (57.1)	6 (75.0)	9 (47.4)	9 (60.0)	NA	0.40
Median (IQR)	2 (5)	3 (5)	0 (13)	2 (4)	NA	0.89
Surgical ICU	(n = 44)	(n = 4)	(n = 20)	(n = 18)	(n = 2)	
Critical care (%)	15 (34.1)	0 (0)	5 (25.0)	10 (55.6)	0 (0)	0.06
Median (IQR)	0 (1)	0 (0)	0 (0.5)	0.5 (1)	0 (0)	0.15
Internal medicine (%)	7 (15.9)	1 (25.0)	6 (30.0)	0 (0)	0 (0)	0.07
Median (IQR)	0 (0)	0 (4)	0 (14)	0 (0)	0 (0)	0.04
Anesthesiologist (%)	4 (9.1)	2 (50.0)	1 (5.0)	1 (5.6)	0 (0)	0.03
Median (IQR)	0 (0)	1 (3)	0 (0)	0 (0)	0 (0)	0.15
Surgeon (%)	21 (47.7)	3 (75.0)	9 (45.0)	9 (50.0)	0 (0)	0.37
Median (IQR)	1.5 (5)	3.5 (4.5)	3 (12.5)	0.5 (5)	0 (0)	0.40
Pediatrician (%)	2 (4.6)	1 (25.0)	0 (0.0)	1 (5.6)	0 (0)	0.18
Median (IQR)	0 (0)	0 (2.5)	0 (0)	0 (0)	0 (0)	0.51
Mixed ICU	(n = 55)	(n = 36)	(n = 3)	(n = 1)	(n = 15)	
Critical care (%)	12 (21.82)	4 (11.1)	0 (0)	1 (100)	7 (46.7)	<0.01
Median (IQR)	0 (0)	0 (0)	0 (0)	4 (0)	0 (1)	<0.01
Internal medicine (%)	45 (81.8)	31 (86.1)	0 (0)	0 (0)	14 (93.3)	<0.01
Median (IQR)	3 (4)	3 (3.5)	0 (0)	0 (0)	3 (10)	0.03
Anesthesiologist (%)	32 (58.18)	21 (58.33)	1 (33.3)	1 (100)	9 (60.0)	0.68
Median (IQR)	1 (2)	1 (2)	0 (5)	5 (0)	1 (3)	0.28
Surgeon (%)	39 (70.9)	26 (72.2)	2 (66.7)	0 (0)	11 (73.3)	0.47
Median (IQR)	2 (4)	2 (3.5)	6 (14)	0 (0)	3 (5)	0.23
Pediatrics (%)	21 (38.2)	16 (44.4)	0 (0)	0 (0)	5 (33.3)	0.36
Median (IQR)	0 (2)	0.5 (2.5)	0 (0)	0 (0)	0 (1)	0.35
Pediatrics ICU	(n = 14)	(n = 3)	(n = 9)	(n = 2)	(n = 0)	
Critical care (%)	4 (28.6)	0 (0)	3 (33.3)	1 (50.0)	NA	0.42
Median (IQR)	0 (1)	0 (0)	0 (1)	1 (2)	NA	0.36
Pediatrician (%)	13 (92.9)	3 (100)	8 (88.9)	2 (100)	NA	0.74
Median (IQR)	4 (5)	4 (1)	4 (17)	2.5 (3)	NA	0.64

Median (IQR) is median number (interquartile range) of specialty physician involved per unit

Table 2. After hour consultant in Thai ICUs

Consultant pattern (%)	All (n = 155)	General (n = 51)	Regional (n = 51)	Academic (n = 36)	Private (n = 17)	p-value
No night shift + host doctor consultation	63 (42.3)	30 (60.0)	17 (35.4)	11 (32.4)	5 (29.4)	0.02
Night shift + host doctor consultation	42 (28.2)	12 (24.0)	17 (35.4)	5 (14.7)	8 (47.1)	0.05
Night shift + non intensivist consultation	32 (21.5)	7 (14.0)	11 (22.9)	10 (29.4)	4 (23.5)	0.39
Night shift + intensivist consultation	12 (8.1)	1 (2.0)	3 (6.3)	8 (23.5)	0 (0)	<0.01

academic hospitals (Table 1). Intensivists are involved in all types of ICUs. Anesthesiologists and surgeons are found only in surgical and mixed ICUs. Less than half of the ICUs have been directed or consulted by a critical care physician with the exception of medical ICUs (Table 1). In addition, the median number for this specialty in Thai ICUs is zero to one. These findings might imply that there is a lack of advocacy for

Table 3. Nurses staff features in Thai ICUs

Nurse staff	All	General	Regional	Academic	Private	p-value
Years of experiences	(n = 155)	(n = 51)	(n = 51)	(n = 36)	(n = 17)	
<3 years (%)	118 (76.1)	39 (76.5)	38 (74.5)	29 (80.6)	12 (70.6)	0.86
% median (IQR)	20.80 (25.7)	17.40 (27.8)	20.80 (22.3)	29.00 (22.5)	26.10 (55.2)	0.12
3-5 years (%)	103 (66.5)	36 (70.6)	29 (56.9)	25 (69.4)	13 (76.5)	0.33
% median (IQR))	13.30 (17.2)	12.50 (25)	10.53 (17.4)	16.67 (12.9)	16.67 (8)	0.03
>5 years (%)	128 (82.6)	43 (84.3)	42 (82.4)	26 (72.2)	17 (100)	0.10
% median (IQR)	62.50 (32.7)	66.70 (37.8)	66.70 (26.8)	51.30 (26.1)	50 (39.8)	0.02
Specialist training	(n = 155)	(n = 51)	(n = 51)	(n = 36)	(n = 17)	
Certificate (%)	132 (85.2)	50 (98.0)	39 (76.8)	33 (91.7)	10 (58.8)	<0.01
% median (IQR)	33.30 (34.6)	40.00 (30)	28.60 (40)	34.90 (30.9)	6.90 (25)	<0.01
APN (%)	36 (23.2)	15 (29.4)	12 (23.5)	8 (22.2)	1 (5.9)	0.26
% median (IQR)	0 (0)	0 (4.6)	0 (0)	0 (0)	0 (0)	0.30

% median (IQR) is median percentage of observed nurse to total containing staff in ICUs (= [number of observed nurse/total number of nurse staff] x 100); certificate is critical care nurse certificate from formal course training
APN = advance practice nurse

Table 4. Patient to nurse ratio categorized by hospital and ICU types

Patient to nurse ratio	All	General	Regional	Academic	Private	p-value
Medical ICU	(n = 42)	(n = 8)	(n = 19)	(n = 15)	(n = 0)	
Morning shift (IQR)	2 (0.5)	2 (0.3)	2 (0)	1.5 (1)	NA	<0.01
Evening shift (IQR)	2 (1)	2 (0.5)	2 (1)	1.5 (1.1)	NA	0.03
Night shift (IQR)	2 (1)	2 (0.5)	2 (1)	1.5 (0.8)	NA	0.01
Surgical ICUs	(n = 44)	(n = 4)	(n = 20)	(n = 18)	(n = 2)	
Morning shift (IQR)	1.8 (0.9)	2.1 (0.3)	2 (0.5)	1.3 (1)	1.5 (0)	<0.01
Evening shift (IQR)	2 (0.8)	2.2 (0.7)	2 (0.8)	1.5 (0.9)	3 (0)	<0.01
Night shift (IQR)	2 (0.8)	2.2 (0.8)	2 (0.7)	1.6 (0.9)	3 (0)	<0.01
Mixed ICUs	(n = 55)	(n = 36)	(n = 3)	(n = 1)	(n = 15)	
Morning shift (IQR)	2 (0.3)	2 (0.1)	2 (0)	1 (0)	2 (2)	0.42
Evening shift (IQR)	2 (0.7)	2 (0.5)	2 (1)	1 (0)	2 (1)	0.38
Night shift (IQR)	2 (1)	2 (0.8)	2 (1)	0.9 (0)	2 (2)	0.28
Pediatric ICUs	(n = 14)	(n = 3)	(n = 9)	(n = 2)	(n = 0)	
Morning shift (IQR)	2 (0.4)	2 (0)	2 (1)	1.4 (0.3)	NA	0.06
Evening shift (IQR)	2.3 (1)	2 (0)	2.7 (0.5)	1.5 (0)	NA	0.02
Night shift (IQR)	2.3 (1)	2 (0)	2.7 (0.5)	1.5 (0)	NA	0.02
All ICUs	(n = 155)	(n = 51)	(n = 51)	(n = 36)	(n = 17)	
Morning shift (IQR)	2 (0.5)	2 (0)	2 (0)	1.3 (1)	2 (1.5)	<0.01
Evening shift (IQR)	2 (0.5)	2 (0.5)	2 (1)	1.5 (0.9)	2 (1)	<0.01
Night shift (IQR)	2 (0.7)	2 (0.5)	2 (1)	1.5 (0.9)	2.6 (1)	<0.01

Patient to nurse ratio is the indicator for nursing workload by measuring how many patients for one nurse (= number of patients per shift/number of nurses)

intensivists and little precedence for them in the Thai health care system. In addition, most of the intensivists are working in academic hospitals.

After-hour consultant coverage is an important issue in the ICU. Blunt et al reported the case-mix-adjusted hospital mortality of ICU patients had improved significantly with an intensivist present when compared to those that do not have an intensivist covering their ICU (standardized mortality ratios 0.81 vs. 1.11 ratio 0.73 [95% CI 0.55-0.97])[5]. However, in our

survey, we found that more than 40 percent of participating ICUs have no night shift doctor and only eight percent of the ICUs have a critical care physician or intensivist covering the night shift. Most of these are located in the academic hospitals' ICUs (Table 2). Lack of night shift physicians, consultation patterns and specialist coverage are crucial issues for the health care systems' problems that can possibly lead to worse outcomes of care in the ICU.

Nursing workloads and nurses' experience are indicators noted in the best practice models and have been shown to impact the patients' outcomes[3,6,7]. In the US, the clinical roles of critical care nurses are to do the majority of patients' assessments, evaluations and care in the ICU. The typically PNR is 2:1[3]. A large survey taken of 10,184 US staff nurses has reported that each additional patient per nurse is associated with a seven percent increase in the likelihood of death within 30 days of admission and a seven percent increase in the odds of "failure to rescue[2]". In our survey, the authors found that the median PNR was at 2:1. Academic hospitals have significantly lower PNR (0.9-1.6:1) and the morning shift has a tendency toward a lower PNR than the evening and night shifts (Table 4). These figures are acceptable as a standard recommendation[3].

In regards to nurses' experience, 82.5% of the participating ICUs report the use of more experienced nurses (more than 5 years) in their ICUs. Of those, the median total proportion is expressed as 62.5%. The proportion decreases in academic and private hospitals' ICUs (51.3% and 50.0% respectively, Table 3). Nurses with less experience, less than 3 years, have a median proportion of 20.8% and there is a higher number of them in academic and private hospital ICUs (29% and 26.1%, respectively; Table 3). These findings imply that academic and private hospital ICUs have a higher rotation and turnover of experienced nurses than seen in general or regional hospital ICUs.

Two post graduate critical care nurse courses in Thailand are short courses, four-month programs, for critical care nurse certification and advanced practice nurse (APN) certification. APNs have the role of collaborating with the critical care team in developing and implementing plans of care[3]. In our survey (Table 3), only a third of ICUs nurses had the critical care nurse certification. Higher proportions of certified critical nurses are found in general hospitals' ICUs (40%) and lowest numbers are found in private hospitals (6.9%). As for certified APNs, only 23.2% of the ICUs have an APN. Of these findings, the greatest deficiency was in critical care nurses. Higher education should be promoted for all ICU nurses.

There were many inescapable limitations. First, distribution of the participating ICUs in the survey is unequal in each of the Thai regions. The estimated values in the present study might be distorted and imprecise. However, regarding bias reduction, the authors attempted to encourage all participating ICUs to send data to us as well as to confirm data during the cleansing process. Second, physicians involved in Thai ICUs had multiple job description in regards to specialties. This survey collected only the primary role of the physicians in ICUs and did not collect the working proportions among all specialties for each physician involved. Third, nurse education was confusing and had a tendency to be misinterpreted between the differences of critical care certification and the APN. Although the data were re-checked the APN numbers might be an over-estimation. However, this study is the pioneer report on physician and nurse characteristics in Thai ICUs and their descriptions.

Conclusion

Critical care physicians are still a scarcity in Thai ICUs. Internists, anesthesiologists and surgeons play important roles in adult ICUs out numbering intensivist physicians. Pediatric ICUs are an isolated specialty working in all ICUs with the exception of the medical ICUs. Nurse burdens in non-academic ICUs are higher than that in academic ICUs. Specialty training of certified critical care nurses include only one third of all ICU nurses. An APN nurse is only available in twenty-five percent of the participating ICUs.

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Potential conflicts of interest

All authors were no conflicts of interest from the present study. The abstract was presented as oral presentation in 4th international critical care conference in Thailand on 27th-29th June 2013.

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ลักษณะของแพทย์และพยาบาลในไอซียูไทย (ICU-RESOURCE I study)

กวีศักดิ์ จิตตวัฒนรัตน์, รังสรรค์ ภูรยานนทชัย, ฉวีวรรณ ธงชัย, กลุ่มวิจัยสมาคมเวชบำบัดวิกฤตแห่งประเทศไทย

วัตถุประสงค์: แพทย์และพยาบาลเป็นทรัพยากรบุคคลที่สำคัญในไอซียู อย่างไรก็ตามไม่มีข้อมูลที่พบได้ในประเทศไทย วัตถุประสงค์สำหรับการศึกษาเพื่อบรรยายลักษณะของแพทย์และพยาบาลที่ทำงานในไอซียูของประเทศไทย

วัสดุและวิธีการ: ข้อมูลการศึกษานี้ได้ฐานข้อมูล ICU RESOURCE I บันทึกข้อมูลเกี่ยวกับลักษณะของแพทย์และพยาบาล การทำงานและภาระงานของไอซียู การทำงานนอกเวลาราชการ ระยะเวลาการทำงานของพยาบาล การศึกษาของพยาบาลและภาระงานของพยาบาลโดยบันทึกเกี่ยวกับสัดส่วนจำนวนของผู้ป่วยต่อพยาบาล

ผลการศึกษา: ไอซียูจำนวน 155 เข้าร่วมในการสำรวจนี้ แพทย์เวชบำบัดวิกฤตพบใน 53 โรงพยาบาล โดยพบค่ามัธยฐานของแพทย์ 0-1 ต่อหน่วย แพทย์เวชบำบัดวิกฤตและอายุรแพทย์ปฏิบัติงานในไอซียูอายุรกรรม อย่างไรก็ตามส่วนใหญ่ของแพทย์เวชบำบัดวิกฤตทำงานในสถาบันฝึกอบรม แพทย์ที่ทำงานในไอซียูศัลยกรรม 2 กลุ่มหลักคือ แพทย์เวชบำบัดวิกฤต (ร้อยละ 34.1) และศัลยแพทย์ (ร้อยละ 47.7) แพทย์ทำงานในไอซียูกุมารเวชศาสตร์คือ กุมารแพทย์และแพทย์เวชบำบัดวิกฤต (ร้อยละ 28.6) น้อยกว่า ร้อยละ 30 ของไอซียูไทยมีแพทย์เวชบำบัดวิกฤต กำกับดูแลนอกเวลาประมาณ ร้อยละ 42.3 ของไอซียูไทยไม่มีแพทย์ประจำนอกเวลาราชการและปรึกษาแพทย์ เจ้าของเป็นรายๆ ค่ามัธยฐานของพยาบาลที่มีระยะเวลาการทำงานมากกว่า 5 ปี ร้อยละ 62.5 สำหรับการฝึกอบรมพิเศษของพยาบาล การฝึกอบรมระยะสั้นเพื่อประกาศนียบัตรพบในไอซียูจำนวน ร้อยละ 85.2 แต่พบพยาบาลเวชปฏิบัติขั้นสูงเพียง ร้อยละ 23.2 และส่วนใหญ่ของภาระงานของผู้ป่วยคนไข้ต่อพยาบาลในไอซียูประมาณ 2:1 ยกเว้นไอซียูในสถาบันฝึกอบรม

สรุป: แพทย์เวชบำบัดวิกฤตในประเทศไทยยังคงขาดแคลนพยาบาลในไอซียูของโรงพยาบาลที่ไม่อยู่ในสถาบันฝึกอบรมมีภาระงานที่สูงกว่าพยาบาลในสถาบันฝึกอบรม ผู้เชี่ยวชาญของพยาบาลเวชบำบัดวิกฤตพบเพียงหนึ่งในสามของพยาบาลทั้งหมด พยาบาลเวชปฏิบัติขั้นสูงพบเพียงหนึ่งในสี่ของไอซียูทั้งหมดในการศึกษา