# Re-Admission within 72 Hours in Thai Surgical Intensive Care Units (Thai-SICU) Study: Characteristics, and Outcomes

Sujaree Poopipatpab MD*[1],
Tanawadee Teeratchanan MD*[1], Kaweesak Chittawatanarat MD, PhD*[2],
Konlawij Trongtrakul MD*[3], the THAI-SICU study group

*[1] *Department of Anesthesiology, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand*
*[2] *Department of Surgery, Chiang Mai University, Chiang Mai, Thailand*
*[3] *Critical Care Division, Department of Emergency Medicine, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand*

***Objective:*** *To identify incidence, characteristics and outcomes of patients who were re-admitted to surgical intensive care units (SICUs).*
***Material and Method:*** *Multicenter prospective cohort study conducted in 9 university-affiliated surgical ICUs in Thailand (THAI-SICU study) from April 2011 to January 2013.*
***Results:*** *A total of 144 patients (3.1%) re-admitted to our surgical ICUs from 4,652 cases were recruited. Re-admission baseline characteristics were advanced age (mean = 71 years), low body mass index, and higher APACHE-II and SOFA score within 24 hours of first ICU admission. Many significant comorbidities were found in the re-admission group, including: hypertension, cardiovascular diseases, and respiratory diseases. ICU mortality and hospital mortality were higher in re-admission group than those in the non re-admission group (20.1% vs. 9.3%, p<0.001 and 27.8% vs. 11.3%, p<0.001, respectively). The relative risk ratio for mortality between re-admission and non re-admission in ICU was 2.17 times and in hospital mortality was 2.46 times greater. Independent potential risk factors for re-admission were age (OR 1.028, 95% CI 1.001-1.051), emergency surgical intervention (OR 1.978, 95% CI 1.027-3.813), transfer back from general wards (OR 4.175, 95% CI 2.020-8.628), and respiratory failure needing mechanical ventilation (OR 2.167, 95% CI 1.065-4.407).*
***Conclusion:*** *Re-admission was found in 3.1% of cases in our surgical ICUs. This problem is associated with significantly higher ICU and hospital mortality. Risk factors of re-admission were patient age, emergency surgery, re-admission from general wards, and need for respiratory support.*

***Keywords:*** *Re-admission, Characteristics, Outcomes, Surgical intensive care unit*

***J Med Assoc Thai 2016; 99 (Suppl. 6): S23-S30***
***Full text. e-Journal:*** *http://www.jmatonline.com*

The intensive care unit (ICU) is a specialized unit in hospital where critically ill patients are closely monitored with sophisticated life support equipment, in combination with suitable medication. ICU care aims mainly to maintain patients near to normal physiology until clinical improvement. In Thailand, tertiary care and university hospitals are usually reserved for more complicated cases. However, ICU quality-of-care studies from our country are limited.

One measure of ICU quality is the percentage of ICU re-admission, defined by patient re-admits within 48-72 hours after first ICU discharge. About 5.1-11.6% of ICU patients were re-admitted worldwide[1-5]. Furthermore, these type of patients usually had longer duration of mechanical ventilation[2], longer length of ICU stay[2,4], and higher morbidity and mortality rate[1,3,4] than those not re-admitted. In addition, about one tenth of ICU discharges[6,7] suffered adverse events; for example, deep vein thrombosis, ICU-acquired infection or sepsis, pulmonary edema, myocardial infarction, etc. Predictors for these adverse outcomes were respiratory rate less than 10 or above 25 breaths per minute, and pulse rate exceeding 110 beats per minute[7].

The aims of this study were to demonstrate (1) the incidence of re-admission to surgical ICU, (2) to identify the risk factors associated with increased risk

***Correspondence to:***
*Trongtrakul K, Critical Care Division, Department of Emergency Medicine, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, 681 Samsen Road, Bangkok 10300, Thailand.*
*Fax: +66-2-2443189*
*E-mail: konlawij@nmu.ac.th*

of being re-admitted, and, finally (3) to demonstrate re-admission mortality outcomes. Further hospital policy and proper management could be initiated following the examination of data.

## Material and Method

This study enrolled participants from the THAI-SICU multi-center study[8], a collaborative study project of 9 University-affiliated surgical ICUs in Thailand to collect data from April 2011 to January 2013. The study protocols were submitted to and approved by ethics and research committees at each institution.

### *Data collection*

The prospectively collected data included patient demographic data, such as age, sex, body mass index (BMI), smoking history, principle diagnosis at first ICU admission, pre-existing comorbiditities, severity of patient on first surgical ICU admission as evaluated by APACHE-II and SOFA score (within first 24 hours), ICU data about ICU admission priorization according to the Task Force of the American College of Critical Care Medicine 1999[9], ICU admission sources, type of ICU admission, operative information about type of surgery, site of operation, and American Society of Anesthesiologists physical status (ASA-status) was collected.

Re-admission was defined as re-entry into an ICU within 72 hours following first ICU discharge during the same hospital stay. Patients who died during their first ICU admission were excluded. Patient outcomes, including surgical ICU mortality and hospital mortality were analyzed. In addition, length of ICU stay and length of hospital stay were also evaluated.

### *Statistical analysis*

Patient discrete variables were expressed as counts and percentages, whereas continuous data were expressed as median and interquartile range 25 and 75. The difference in patients' characteristics and mortality (surgical ICU mortality and hospital mortality) were analyzed using Chi-square test or Fisher's exact test when they were appropriate for categorical data, and by Mann-Whitney U test for continuous data. The association of individual variables was analyzed in bivariate logistic regression, and then multivariable logistic regression was done. Potential variables were included in the multivariable logistic regression model if they were associated with ICU re-admission with *p*-value lees than 0.20 in the bivariate logistic regression. The *p*-values less than 0.05 were considered statistically significant. This study used STATA, version 11.0 (STATA Inc., College Station, TX) for statistical analysis

## Results

Among 4,652 participants who were enrolled in our study, 144 patients (3.1%) were re-admitted to surgical ICU during their hospital stay. Comparing baseline characteristics between re-admitted and non re-admitted patients, we found subjects in the re-admission group were older (71 (57-79.5) years old vs. 64 (51-75) years old, $p<0.001$), had lower BMI (21.88 (18.34-24.44) kg/m$^2$ vs. 22.27 (19.60-25.26) kg/m$^2$, $p = 0.01$) and more severe in clinical status evaluated by APACHE-II score and SOFA score (13 (10-19) vs. 10 (7-15), $p<0.001$ and 4 (2-7) vs. 2 (1-5), $p<0.001$, respectively). Principle diagnosis leading to re-admission showed significant differences between the re-admission and non re-admission group ($p<0.001$), especially cardiovascular and respiratory problems (25.7% vs. 15.6% and 20.8% vs. 7.3%, respectively) (Table 1). Moreover, pre-existing hypertension, cardiovascular diseases, and respiratory diseases were predominantly found in re-admission patients (59.0% vs. 48.4%, $p = 0.01$, 34.7% vs. 21.1%, $p<0.001$, and 14.6% vs. 8.5%, $p = 0.01$, respectively). However, there was no association between smoking history and re-admission ($p = 0.93$) (Table 1).

Medical problems were found in most of the re-admission population (55.6%), while elective surgery cases were most commonly enrolled in the non re-admission group (50.6%). Moreover, the sources of ICU in re-admission were mostly came form general ward (60.1%) (Table 2). In addition, the unstable patients (priority I and III) were mostly found larger proportion in re-admission ICU group, whereas priority II (stable patients) was higher in non re-admission group (Table 2).

Abdominal and colorectal surgery, in addition with head, neck and maxillofacial surgery were identified significant difference between re-admission versus non re-admission (both $p<0.05$). The American Society of Anesthesiologists' physical status classification was applied to categorize operative status of our patients and statistical differences between these two groups ($p = 0.04$). Coincidentally we found that AKI, sepsis syndrome and mechanical ventilation were more common and showed a statistically significant difference (31.9% vs. 16.4%, $p<0.001$; 34.7% vs. 19.0%, $p<0.001$; and 78.5 vs. 61.6%, $p<0.001$, respectively) (Table 2).

Comparing primary outcomes, re-admitted

**Table 1.** Baseline characteristics of surgical intensive care patients according to re-admission and non re-admission group

| Baseline characteristics | All patients (n = 4,652) | Re-admission (n = 144) | Non re-admission (n = 4,508) | *p*-value |
|---|---|---|---|---|
| Age (years-old) | 64 (51-75) | 71 (57-79.5) | 64 (51-75) | <0.001 |
| Female (n (%)) | 1,923 (41.3) | 56 (38.9) | 1,867 (41.4) | 0.540 |
| Body mass index (kg/m$^2$) | 22.27 (19.56-25.21) | 21.88 (18.34-24.44) | 22.27 (19.60-25.26) | 0.010 |
| APACHE-II score | 10 (7-15) | 13 (10-19) | 10 (7-15) | <0.001 |
| SOFA score at day-1 | 2 (1-5) | 4 (2-7) | 2 (1-5) | <0.001 |
| Principle diagnosis of first ICU admission | | | | <0.001 |
| Cardiovascular problems (n (%)) | 739 (15.6) | 37 (25.7) | 702 (15.6) | |
| Respiratory problems (n (%)) | 361 (7.8) | 30 (20.8) | 331 (7.3) | |
| Abdominal problems (n (%)) | 1,869 (40.2) | 45 (31.3) | 1,824 (40.5) | |
| Neurological problems (n (%)) | 236 (5.1) | 4 (2.8) | 232 (5.2) | |
| Renal problems (n (%)) | 373 (8.0) | 4 (2.8) | 369 (8.2) | |
| Obstetric and gynecology (n (%) | 124 (2.7) | 1 (0.7) | 123 (2.7) | |
| Trauma (n (%)) | 327 (7.0) | 3 (2.1) | 324 (7.2) | |
| Others diagnosis* (n (%)) | 451 (9.7) | 10 (7.0) | 441 (9.7) | |
| Pre-existing comorbidities (may be more than one) | | | | |
| Hypertension (n (%)) | 2,268 (48.8) | 85 (59.0) | 2,183 (48.4) | 0.010 |
| Cardiovascular diseases[!] (n (%)) | 1,001 (21.5) | 50 (34.7) | 951 (21.1) | <0.001 |
| Previous stroke (n (%)) | 276 (5.9) | 8 (5.6) | 268 (5.9) | 0.850 |
| Respiratory diseases[$] (n (%)) | 406 (8.7) | 21 (14.6) | 385 (8.5) | 0.010 |
| Diabetes mellitus (n (%)) | 1,018 (21.9) | 34 (23.6) | 984 (21.8) | 0.610 |
| Chronic kidney disease (n (%)) | 442 (9.5) | 20 (13.9) | 422 (9.4) | 0.070 |
| Malignancy (n (%)) | 727 (15.6) | 24 (16.7) | 703 (15.6) | 0.730 |
| Miscellaneous[#] (n (%)) | 98 (2.1) | 4 (2.8) | 94 (2.1) | 0.570 |
| Smoking history | | | | 0.930 |
| Current smoker (n (%)) | 557 (12.0) | 18 (12.5) | 539 (12.0) | |
| Ex-smoker (n (%)) | 1,148 (24.7) | 37 (25.7) | 1,111 (24.7) | |
| Non-smoker (n (%)) | 2,947 (63.4) | 89 (61.8) | 2,858 (63.4) | |

* Other diagnosis included hematologic diseases, metabolic complication, and musculo-skeletal diseases. [!] Cardiovascular diseases included coronary artery heart disease, congestive heart failure, vascular insufficiency diseases. [$] Respiratory diseases included asthma, chronic obstructive pulmonary diseases, and others. [#] Miscellaneous included HIV/AIDS, immunological diseases, and organ transplantation

APACHE-II score = Acute Physiology and Chronic Health Evaluation II score; SOFA score = Sequential Organ Failure Assessment score; HIV or AIDS = Human Immunodeficiency Virus or Acquired Immune Deficiency Syndrome; ICU = intensive care unit

patients had significantly higher ICU mortality (20.1% vs. 9.3%, $p<0.001$) and hospital mortality (27.8% vs. 11.3%, $p<0.001$) than non re-admitted. The relative risk ratios of ICU mortality and hospital mortality for re-admitted over non re-admitted were 2.17 and 2.46 times, respectively, with level of statistical significance as mentioned above. In addition, there were also longer ICU stays (4 (2-10) days vs. 2 (1-4) days, $p<0.001$) and hospital length of stay in re-admission (23 (14-47) days vs. 15 (9-25) days, $p<0.001$). Furthermore, there were more patients at day 28 after first ICU admission (33.3% vs. 13.2%, respectively, $p<0.001$ (Table 3).

Using multivariable logistic regression, advanced age (OR 1.028; 95% CI 1.001-1.051), status post-emergency surgical intervention at first ICU admission (OR 1.978, 95% CI 1.027-3.813), transfer from general wards after discharge from the ICU (OR 4.175, 95% CI 2.020-8.628), and respiratory failure requiring mechanical ventilation (OR 2.167, 95% CI 1.065-4.407) were identified as risk factors for ICU re-admission.

## Discussion

Re-admission rate within 72 hours, following discharge from our cohort of surgical ICUs, was 3.1%.

**Table 2.** Intensive care characteristics of surgical intensive care patients according to re-admission and non re-admission group

| Variables | All patients (n = 4,652) | Re-admission (n = 144) | Non re-admission (n = 4,508) | *p*-value |
|---|---|---|---|---|
| Type of ICU admission | | | | |
| Available data | 4,652 | 144 | 4,508 | <0.001 |
| Emergency surgery (n (%)) | 1,148 (24.7) | 33 (22.9) | 1,115 (24.7) | |
| Elective surgery (n (%)) | 2,311 (49.7) | 28 (19.4) | 2,283 (50.6) | |
| Medical problems[a] (n (%)) | 1,003 (21.6) | 80 (55.6) | 923 (20.5) | |
| Sources of ICU admission | | | | |
| Available data | 4,593 | 143 | 4,450 | <0.001 |
| Emergency department (n (%)) | 477 (10.4) | 6 (4.2) | 471 (10.6) | |
| Operating theater/Recovery room (n (%)) | 3,235 (70.4) | 48 (33.6) | 3,187 (71.6) | |
| General wards (n (%)) | 794 (17.3) | 86 (60.1) | 708 (15.9) | |
| Others intensive care units* (n (%)) | 87 (1.9) | 3 (2.1) | 84 (1.9) | |
| Priority of ICU admission[#] | | | | |
| Available data | 4,620 | 143 | 4,477 | <0.001 |
| Priority I (n (%)) | 1,056 (22.9) | 55 (38.5) | 1,001 (22.4) | |
| Priority II (n (%)) | 3,398 (73.6) | 77 (53.9) | 3,321 (74.2) | |
| Priority III (n (%)) | 133 (2.9) | 11 (7.7) | 122 (2.7) | |
| Priority IV (n (%)) | 33 (0.7) | 0 (0.0) | 33 (0.7) | |
| Site of operation | | | | |
| Available data | 3,517 | 56 | 3,461 | |
| Head, neck and maxillofacial (n (%)) | 420 (9.0) | 4 (2.8) | 416 (9.2) | 0.008 |
| Abdominal and colorectal (n (%)) | 2,207 (47.4) | 33 (22.9) | 2,174 (48.2) | <0.001 |
| Orthopedics[!] (n (%)) | 533 (11.5) | 12 (8.3) | 521 (11.6) | 0.230 |
| Other types of surgery[$] (n (%)) | 357 (7.7) | 7 (4.9) | 350 (7.8) | 0.200 |
| American Society of Anesthesiologist physical status classification (ASA-status) | | | | |
| Available data | 3,564 | 67 | 3,497 | 0.040 |
| ASA-I (n (%)) | 235 (6.6) | 1 (1.5) | 234 (6.7) | |
| ASA-II (n (%)) | 1,131 (31.7) | 12 (17.9) | 1,119 (32.0) | |
| ASA-III (n (%)) | 1,748 (49.1) | 41 (61.2) | 1,707 (48.8) | |
| ASA-IV (n (%)) | 398 (11.2) | 12 (17.9) | 386 (11.0) | |
| ASA-V (n (%)) | 49 (1.4) | 1 (1.5) | 48 (1.4) | |
| ASA-VI (n (%)) | 3 (0.1) | 0 (0.0) | 3 (0.1) | |
| Co-morbidity during ICU stay | | | | |
| Acute kidney injury (n (%)) | 786 (16.9) | 46 (31.9) | 740 (16.4) | <0.001 |
| Sepsis syndrome (n (%)) | 907 (19.5) | 50 (34.7) | 857 (19.0) | <0.001 |
| Respiratory failure requiring respiratory ventilation (n (%)) | 2,869 (61.72) | 112 (77.8) | 2,757 (61.2) | <0.001 |

[a] Medical admissions were composed of surgical diseases that could be treated with medication alone, without surgery (such as acute cholangitis, acute pancreatitis, sepsis that could be treated with medication alone, etc.); * Other intensive care units included cardiac care unit (CCU) and other types of intensive care unit; [!] Orthopedic surgery included all extremities and spine surgery; [$] Other types of surgery included thoracic, vascular, and gynecologic and obstetric surgery; [#] Priority of ICU admission was classified according to Task Force of the American College of Critical Care Medicine[12]: priority-I comprises of critical and unstable illness and requiring intensive treatment and monitoring that cannot be provided outside of the ICU, and patients have no limits placed on the extent of therapy they are to receive because they have a significant likelihood of recovery; priority-II comprised of patients who required intensive monitoring because they may need immediate intervention and no therapeutic limits for these patients; priority-III comprised of unstable critically ill patients but with a low likelihood of recovery because of the severity of acute diseases and comorbidities, that means these type of patients need treatment to relieve their acute illness; and priority-IV includes patients who have little or no anticipated benefit from ICU admission; however, limits on therapeutic efforts may be set based on individual or unusual circumstances, and at the discretion of the ICU Director; American Society of Anesthesiologists physical status classification (ASA-status): ASA-I, normal healthy patient; ASA-II, patient with mild systemic disease; AS-III, patient with severe systemic disease; ASA-IV, patient with severe systemic disease that is a constant threat to life; ASA-V, moribund patient who is not expected to survive without surgery; and ASA-VI, a declared brain-dead patient whose organs are being removed for donor purposes

When compared to international studies on ICU re-admission, for example, data from United States ICUs by Kramer AA et al[10] demonstrated a re-admission rate of 6.1%[14], and another study from Europe (Metnitz PG et al)[1] showed 5.1%. However, the above-mentioned studies collected data from mixed medical and surgical ICUs.

Surgical ICUs re-admission incidence ranged from 0.9-13.4%[3,11]. The highest incidence of surgical ICU re-admission in the same hospitalization (at 13.4%)

**Table 3.** Outcomes of surgical intensive care patients according to re-admission and non re-admission group

| Outcomes | All patients (n = 4,652) | Re-admission to SICU (n = 144) | Non re-admission (n = 4,508) | *p*-value |
|---|---|---|---|---|
| ICU mortality (n (%)) | 447 (9.6) | 29 (20.1) | 418 (9.3) | <0.001 |
| Hospital mortality (n (%)) | 550 (11.8) | 40 (27.8) | 510 (11.3) | <0.001 |
| ICU length of stay (days) | 2 (1-4) | 4 (2-10) | 2 (1-4) | <0.001 |
| Hospital length of stay (days) | 15 (9-26) | 23 (14-47) | 15 (9-25) | <0.001 |
| Stay in hospital at day-28 after first ICU admission (n (%)) | 642 (13.8) | 48 (33.3) | 594 (13.2) | <0.001 |

ICU = intensive care unit

**Table 4.** Multivariable logistic regression demonstrated factors that predicted re-admission in our cohort

| Variables | Crude OR | 95% CI | Adjusted OR | 95% CI |
|---|---|---|---|---|
| Age (year-old) | 1.027 | 1.015-1.038 | 1.028 | 1.001-1.051 |
| Body mass index (kg/m$^2$) | 0.950 | 0.915-0.986 | 0.968 | 0.910-1.030 |
| APACHE-II score | 1.059 | 1.039-1.080 | 0.991 | 0.910-1.046 |
| SOFA score | 1.115 | 1.074-1.158 | 1.035 | 0.924-1.159 |
| Hypertension | 1.534 | 1.095-2.150 | 1.671 | 0.870-3.209 |
| Cardiovascular diseases | 1.990 | 1.401-2.825 | 1.363 | 0.720-2.581 |
| Respiratory diseases | 1.828 | 1.138-2.938 | 1.095 | 0.452-2.651 |
| Chronic kidney disease | 1.562 | 0.964-2.531 | 0.628 | 0.234-1.682 |
| ASA class I | Ref | | | |
| ASA class II | 2.509 | 0.325-19.393 | 1.041 | 0.128-8.439 |
| ASA class III | 5.620 | 0.769-41.051 | 1.207 | 0.149-9.750 |
| ASA class IV | 7.275 | 0.940-56.308 | 0.970 | 0.106-8.865 |
| ASA class V & VI | 4.680 | 0.288-76.087 | - | - |
| Unstable status at ICU admission | 2.552 | 1.825-3.570 | 1.556 | 0.581-2.298 |
| Elective surgery | Ref | | | |
| Emergency Surgery | 2.413 | 1.451-4.013 | 1.978 | 1.027-3.813 |
| Medical problems admission | 7.067 | 4.565-10.941 | 1.079 | 0.247-4.723 |
| Operative theater/recovery room | Ref | | | |
| Emergency department | 0.846 | 0.360-1.987 | 0.727 | 0.165-3.201 |
| General wards | 8.065 | 5.613-11.588 | 4.175 | 2.020-8.628 |
| Other intensive care units | 2.371 | 0.724-0.020 | - | - |
| Head, neck and maxillofacial surgery | 0.271 | 0.103-0.763 | 0.707 | 0.234-2.134 |
| Abdominal and colorectal surgery | 0.319 | 0.215-0.473 | 0.612 | 0.337-1.110 |
| Acute kidney injury | 2.390 | 1.669-3.423 | 1.854 | 0.908-3.782 |
| Sepsis syndrome | 2.266 | 1.595-3.219 | 0.597 | 0.271-1.313 |
| Respiratory support | 2.223 | 1.494-3.308 | 2.167 | 1.065-4.407 |

APACHE-II score = Acute Physiology and Chronic Health Evaluation II score; SOFA score = Sequential Organ Failure Assessment score; ASA class = American Society of Anesthesiologists physical status classification; ICU = intensive care unit

was demonstrated by Kaben AA et al[3]. They also demonstrated an early re-admission (within 48 hours), 2-7 day period, and late re-admission (more than one week), the proportion of re-admission was 2.0% (57 of 2,852), 5.2% (148 of 2,852) and 6.2% (176 of 2,852), respectively.

Additional evidence from systematic review by Rosenberg AL and Watts C[9], identified a re-admission rate estimated at 7% (range, 4-14%). The variety of re-admission rates between each center was probably due to different types of patient admission[12], different sources of admission, ratio of healthcare worker to patient ratio (doctor to patient ratio and nurse to patient ratio), patient severity before or during ICU admission, and duration of study period[3,12].

Furthermore, Rosenberg AL[9] found the main conditions leading to re-admission were pulmonary and cardiac problems. Comparing our study, we identified that acute kidney injury, sepsis syndrome, and respiratory failure requiring respiratory support were more predominant in re-admission than non re-admission, although after adjusting the covariates; these factors were not significant in multivariable logistic regression model.

The commonest cause of our patient re-admission was medical problems (55.6%). This emphasized that after discharge from surgical ICU, patients should be monitored for potential adverse events. These data coincide with Chan KS et al[4], who found over half of discharge ICU patients (66.1%) developed new complications. This might be explained by a limit in general ward resources to provide complex disease care for recently discharged ICU patients[13,14].

Finally, the mortality of re-admission patients in our cohort was double that of those not re-admitted, (2.17-times in ICU mortality and 2.46-times in hospital mortality). When compared with data from Rosenberg AL[9], the hospital mortality rates were identified at 2- to 10-times higher for re-admission than non re-admission. In addition, the predictors that warn of ICU re-admission in Rosenberg AL[9] were patient vital signs, especially derangement of respiratory rate, heart rate, and pulmonary function impairment at the time of ICU discharge. However, patient age, emergency surgical intervention, patient re-admission transfer from general wards, and respiratory failure requiring mechanical ventilation were identified as independent predictors for re-admission in our study.

To the best of our knowledge, this was the first and largest study about re-admission of surgical ICU patients in Thailand. Data were collected from the leading university hospitals in Thailand, including from northern, north-eastern, southern, and central regions of Thailand. These can provide a good representation of Thai surgical ICU re-admission rate, and could be a source of information for developing our ICU quality in the future. However, as a multicenter prospective cohort study, our study had some limitations. First, we collected data only from university-based surgical ICUs in Thailand. These ICUs were referral centers and patients usually have more severe and more complicated presentations than in general or provincial hospitals. Moreover, we enrolled data only from surgical ICU. That means our setting might not be able to represent medical ICU re-admission characteristics. Second, we designed our study to follow patients for only 72 hours after ICU discharge; ICU re-admissions that happened after 72 hours were not included in our study. Third, although, we had well-organized pre-planning discussions for a large multicenter registry study, specific reasons in each center altered the number of available re-admission patients. For example, the difference in policy at each center about dealing with complicated patients after discharge from the ICU, limited backup resources in each center, and their own style of medical practice. Finally, we had no data about long-term outcomes beyond 28 days for our re-admission patients.

**Conclusion**

In this cohort, we found 3.1% of surgical ICU patients required re-admission after ICU discharge. Re-admission is associated with significantly higher ICU and hospital mortality than those not re-admitted. Independent risk factors of re-admission were patient age, post-emergency surgery, re-admission from general wards, and respiratory failure needed for respiratory support.

**What is already known on this topic?**

One measure of ICU quality is the percentage of ICU re-admission, defined by patient re-admits within 48-72 hours after first ICU discharge. In Thailand, tertiary care and university hospitals are usually reserved for more complicated cases. However, ICU quality-of-care studies from our country are limited.

**What this study adds?**

This present study demonstrated the incidence, risk factors and mortality outcomes of re-admitted patients in surgical intensive care unit in Thailand.

**Acknowledgements**

We very much appreciate and are very thankful to the members of the Thai-SICUs study group and all co-ordinators (including Chittawatanarat K, Chaiwat O, Morakul S, Pipanmekaporn T, Thawitsri T, Wacharasint P, Fuengfoo P, Chatmongkolchart S, Akaraborworn O, Pathonsamit C, Chanthawong S, Chau-In W, Kusumaphanyo C, Buppha P, Somrat C, Kongsayreepong S) who provided us with the THAI-SICU database for analyzing this study. The Medical Association of Thailand provided the publication fund for this study (funding of Prasert Prasarttong-osoth).

**The THAI-SICU study group are listed below**

Suneerat Kongsayreepong, Onuma Chaiwat (Siriraj Hospital, Mahidol University, Bangkok), Kaweesak Chittawatanarat, Tanyong Pipanmekaporn (Chiang Mai University, Chiang Mai) Sunthiiti Morakul (Ramathibodi Hospital, Bangkok), Thammasak Thawitsri, Somrat Charuluxananan (King Chulalongkorn Memorial Hospital, Bangkok), Petch Wacharasint, Pusit Fuengfoo (Phramongkutklao Hospital, Bangkok), Sunisa Chatmongkolchart, Osaree Akaraborworn (Prince of Songkla University, Songkhla), Chompunoot Pathonsamit, Sujaree Poopipatpab (Navamindradhiraj University, Bangkok), Sarinya Chanthawong, Waraporn Chau-In (Khon Kaen University, Khon Kaen), Chaiyapruk Kusumaphanyo, Phakapan Buppha (Srinakharinwirot University).

**Potential conflicts of interest**

None.

**References**

1. Metnitz PG, Fieux F, Jordan B, Lang T, Moreno R, Le Gall JR. Critically ill patients readmitted to intensive care units—lessons to learn? Intensive Care Med 2003; 29: 241-8.
2. Campbell AJ, Cook JA, Adey G, Cuthbertson BH. Predicting death and readmission after intensive care discharge. Br J Anaesth 2008; 100: 656-62.
3. Kaben A, Correa F, Reinhart K, Settmacher U, Gummert J, Kalff R, et al. Readmission to a surgical intensive care unit: incidence, outcome and risk factors. Crit Care 2008; 12: R123.
4. Chan KS, Tan CK, Fang CS, Tsai CL, Hou CC, Cheng KC, et al. Readmission to the intensive care unit: an indicator that reflects the potential risks of morbidity and mortality of surgical patients in the intensive care unit. Surg Today 2009; 39: 295-9.
5. Frost SA, Alexandrou E, Bogdanovski T, Salamonson Y, Davidson PM, Parr MJ, et al. Severity of illness and risk of readmission to intensive care: a meta-analysis. Resuscitation 2009; 80: 505-10.
6. McLaughlin N, Leslie GD, Williams TA, Dobb GJ. Examining the occurrence of adverse events within 72 hours of discharge from the intensive care unit. Anaesth Intensive Care 2007; 35: 486-93.
7. Chaboyer W, Thalib L, Foster M, Ball C, Richards B. Predictors of adverse events in patients after discharge from the intensive care unit. Am J Crit Care 2008; 17: 255-63.
8. Chittawatanarat K, Chaiwat O, Morakul S, Pipanmekaporn T, Thawitsri T, Wacharasint P, et al. A multi-center Thai university-based surgical intensive care units study (THAI-SICU study): methodology and ICU characteristics. J Med Assoc Thai 2014; 97 (Suppl 1): S45-54.
9. Rosenberg AL, Watts C. Patients readmitted to ICUs*: a systematic review of risk factors and outcomes. Chest 2000; 118: 492-502.
10. Kramer AA, Zimmerman JE. A predictive model for the early identification of patients at risk for a prolonged intensive care unit length of stay. BMC Med Inform Decis Mak 2010; 10: 27.
11. Nishi GK, Suh RH, Wilson MT, Cunneen SA, Margulies DR, Shabot MM. Analysis of causes and prevention of early readmission to surgical intensive care. Am Surg 2003; 69: 913-7.
12. Tam OY, Lam SM, Shum HP, Lau CW, Chan KK, Yan WW. Characteristics of patients readmitted to intensive care unit: a nested case-control study. Hong Kong Med J 2014; 20: 194-204.
13. Whittaker J, Ball C. Discharge from intensive care: a view from the ward. Intensive Crit Care Nurs 2000; 16: 135-43.
14. Chaboyer W, Gillespie B, Foster M, Kendall M. The impact of an ICU liaison nurse: a case study of ward nurses' perceptions. J Clin Nurs 2005; 14: 766-75.
15. Egol A, Fromm R, Guntupalli KK, Fitzpatrick M, Kaufnam D, Nasraway S, et al. Guidelines for intensive care unit admission, discharge, and triage. Task Force of the American College of Critical Care Medicine, Society of Critical Care Medicine. Crit Care Med 1999; 27: 633-8.

## การเข้ารับการรักษาซ้ำในหออภิบาลผู้ป่วยภาวะวิกฤตทางศัลยกรรม: คุณลักษณะและผลลัพธ์

สุจารีย์ ภู่พิพัฒน์ภาพ, กลวิชย์ ตรองตระกูล, ธนาวดี ธีรัชฌานันท์, กวีศักดิ์ จิตตวัฒนรัตน์, กลุ่มศึกษา THAI-SICU

**วัตถุประสงค์:** เพื่อศึกษาอุบัติการณ์, คุณลักษณะและผลลัพธ์ที่เกิดในผู้ป่วยที่เข้ารับการรักษาซ้ำ ในหออภิบาลผู้ป่วยภาวะวิกฤตทางศัลยกรรม

**วัสดุและวิธีการ:** การศึกษานี้เป็นการศึกษาเชิงวิเคราะห์แบบเก็บข้อมูลไปข้างหน้า ในหออภิบาลผู้ป่วยภาวะวิกฤตทางศัลยกรรมของคณะแพทยศาสตร์ 9 แห่งในประเทศไทย เก็บข้อมูลตั้งแต่เดือนเมษายน พ.ศ. 2554 ถึง เดือนมกราคม พ.ศ. 2556

**ผลการศึกษา:** จำนวนผู้ป่วยที่เข้ารับการรักษาซ้ำมีจำนวน 144 ราย (ร้อยละ 3.1) จากผู้ป่วยทั้งหมด 4,652 ราย ที่เข้ารับการรักษาในหออภิบาลผู้ป่วยภาวะวิกฤตทางศัลยกรรม คุณลักษณะของผู้ป่วยที่เข้ารับการรักษาซ้ำในหออภิบาลที่แตกต่างจากผู้ป่วยที่ไม่ได้รับการรักษาซ้ำได้แก่ อายุมากกว่า, ดัชนีมวลกายต่ำกว่า และความรุนแรงของโรคสูงกว่า เมื่อประเมินด้วย APACHE-II และ SOFA score นอกจากนั้นในผู้ป่วยที่เข้ารับการรักษาซ้ำในหออภิบาลมีอัตราส่วนของภาวะความดันโลหิตสูง, โรคหัวใจและหลอดเลือด, และโรคทางระบบทางเดินหายใจสูงกว่าผู้ป่วยที่ไม่ได้การรักษาซ้ำในหออภิบาลอย่างมีนัยสำคัญทางสถิติผลการศึกษาพบว่า อัตราการเสียชีวิตในหออภิบาลผู้ป่วยภาวะวิกฤต ทางศัลยกรรมและในโรงพยาบาลของผู้ป่วยที่เข้ารับการรักษาซ้ำสูงกว่ากลุ่มที่ไม่เข้ารับการรักษาซ้ำอย่างมีนัยสำคัญทางสถิติ (ร้อยละ 20.1 เทียบกับร้อยละ 9.3, $p<0.001$ และร้อยละ 27.8 เทียบกับร้อยละ 11.3, $p<0.001$ ตามลำดับ) โดยพบว่าอัตราการเสียชีวิตในหออภิบาลและอัตราการเสียชีวิตในโรงพยาบาลของกลุ่มผู้ป่วยที่เข้ารับการรักษาซ้ำมากกว่ากลุ่มที่ไม่ได้รักษาซ้ำอยู่ 2.17 เท่า และ 2.46 เท่า ตามลำดับ เมื่อทำการวิเคราะห์ควบคุมอิทธิพลโดยใช้ วิธีสัมประสิทธิ์ถดถอยโลจิสติคเชิงพหุ พบว่าปัจจัยที่ส่งผลต่อการเข้ารักษาซ้ำในหออภิบาลคือ อายุ (OR 1.028; 95% CI 1.001-1.051), ได้รับการผ่าตัดแบบฉุกเฉิน (OR 1.978; 95% CI 1.027-3.813), ผู้ป่วยรับย้ายมาจากหอผู้ป่วยสามัญ (OR 4.175; 95% CI 2.020-8.628), และการใช้เครื่องช่วยหายใจเนื่องจากภาวะการหายใจล้มเหลว (OR 2.167; 95% CI 1.065-4.407)

**สรุป:** จากผลการศึกษาผู้ป่วยที่มีการเข้ารับการรักษาซ้ำในหออภิบาลผู้ป่วยภาวะวิกฤตทางศัลยกรรมพบว่ามีอุบัติการณ์ร้อยละ 3.1 และภาวะดังกล่าวมีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติต่ออัตราเสียชีวิตในหออภิบาลผู้ป่วยภาวะวิกฤต และอัตราการเสียชีวิตโรงพยาบาล นอกจากนั้นปัจจัยเสี่ยงต่อการเข้ารับการรักษาซ้ำในหออภิบาล ได้แก่ อายุของผู้ป่วย, การผ่าตัดแบบฉุกเฉิน, ผู้ป่วยรับย้ายจากหอผู้ป่วยสามัญและการใช้เครื่องช่วยหายใจ เนื่องจากภาวะการหายใจล้มเหลว