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Secondary Analysis on Pressure Injury in Intensive Care Units

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Abstract

Patients with Pressure injuries (PIs) may have pain and discomfort, which results in poorer patient outcomes and additional cost for treatment. This study was a part of larger research project that aimed at prediction modeling using a big data. The purpose of this study were to describe the characteristics of patients with PI in critical care; and to explore comorbidity and diagnostic and interventive procedures that have been done for patients in critical care. This is a secondary data analysis. Data were retrieved from a large clinical database, MIMIC-III Clinical database. The number of unique patients with PI was 2,286 in total. Approximately 60% were male and 68.4% were White. Among the patients, 9.9% were dead. In term of discharge disposition, 56.2% (33.9% Home, 22.3% Home Health Care) where as 32.3% were transferred to another institutions. The rest of them were hospice (0.8%), left against medical advice (0.7%), and others (0.2%). The top three most frequently co-existing kinds of diseases were Hypertension, not otherwise specified (NOS), congestive heart failure NOS, and Acute kidney failure NOS. The number of patients with PI who have one or more procedures was 2,169 (94.9%). The number of unique procedures was 981. The top three most frequent procedures were 'Venous catheterization, not elsewhere classified,' and 'Enteral infusion of concentrated nutritional substances.' Patient with a greater number of comorbid conditions were likely to have longer length of ICU stay (r=.452, p<.001). In addition, patient with a greater number of procedures that were performed during the admission were strongly tend to stay longer in hospital (r=.729, p<.001). Therefore, prospective studies focusing on comorbidity; and diagnostic and preventive procedures are needed in the prediction modeling of pressure injury development in ICU patients.

Keywords: *Pressure injury, critical care, intensive care unit, comorbidity*

1. Introduction

Pressure injuries (PIs) are a common issue among intensive care unit (ICU) patients. PIs are localized lesions to the skin or underlying tissues [1]. They result from pressure or shear, often develop at bony prominences. Patients with PI may have pain and discomfort, which results in poorer patient outcomes [2]. In addition, PI cause longer the length of hospital stay [3]. Extended hospital stay may result in additional cost up to $700,000 per year. The cost for PI treatment per patient for full-thickness skin loss or deeper (underlying muscle, tendon, cartilage or bone) were from $5900 to $21410 [4]. In Europe, treatment cost of

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PI per patient per day were from $2.08 to $573.56 depending on care settings [5]. Patients with PI are more likely to discharge to an intermediate care institution or skilled nursing facility rather than home [4, 6].

Lots of research studies in different countries examined PI incidence and identified risk factors for PI development [7-11]. Multiple factors contribute to PIs in critical patients, for example, age, gender, body weight, limited mobility, ventilators, and use of vasopressors [2, 12]. This study is a part of larger research project that aimed at prediction modeling using a big data. The purpose of this study was to describe the characteristics of patients with PI in critical care and explore co-morbidity and diagnostic and interventive procedures that have been done for this specific group of patients in critical care.

2. Methods

This study is a secondary analysis using an electronic data from a clinical database. Data were retrieved from a large clinical database, MIMIC-III. MIMIC-III Clinical database is a publicly available database. It contains over forty thousand critical care data of the patients who have admitted to the Beth Israel Deaconess Medical Center between 2001 and 2012 [13]. The database provides a diverse and large collection of intensive care unit (ICU) patient data. It includes 651,047 records of disease information that are represented with the International Classification of Diseases (ICD) codes. For the purpose of this study, a dataset was created by querying patients with PI from the database. The patients were identified using the Clinical Classifications Software for ICD-9-CM [14]. Descriptive statistics were used for data analysis. Pearson's correlation were used to examine the relation between length of ICU stay and number of diseases or procedures done for the patient during the hospitalization.

3. Results and Discussion

The number of the records that were relevant to this study was 4,264. After data cleaning process, the number of unique patients with PI was 2,286. Approximately 60% were male and 68.4% were White. Table 1 summarizes the characteristics of the patients. We were not able to describe age clearly as true age were obscure to comply with HIPAA regulations.

]Table 1. Characteristics of the patents (N=2,286)

Variable	Categories	Freq (%)
Gender	Male	1368 (59.8)
	Female	918 (40.2)
Ethnicity	White	1564 (68.4)
	Black	232 (10.1)
	Hispanic	96 (4.2)
	Asian	87 (3.8)
	Others	87 (3.8)
	Unknown	220 (9.6)
Marital status	Married	862 (37.7)
	Single	510 (22.3)
	Widowed	284 (12.4)
	Divorced	138 (6.0)
	Separated	21 (0.9)
	Unknown	13 (0.6)
	Missing	458 (20.0)

	Catholic	809 (35.4)
	Protestant Quaker	267 (11.7)
	Jewish	224 (9.8)
	Muslim	9 (0.4)
	Greek orthodox	20 (0.9)
	Buddhist	6 (0.3)
	Other	174 (7.6)
	Not specified	429 (18.8)
	Unobtainable	330 (14.4)
	Missing	18 (0.8)
Admission type	Emergency	1614 (70.6)
	Newborn	358 (15.7)
	Elective	255 (11.2)
	Urgent	59 (2.6)
Insurance	Government	65 (2.8)
	Medicaid	245 (10.7)
	Medicare	1074 (47.0)
	Private	876 (38.3)
	Self-pay	26 (1.1)
	Others	5 (0.2)

Among the patients, 9.9% were dead. In term of discharge disposition, 56.2% (33.9% Home, 22.3% Home Health Care) where as 32.3% were transferred to another institutions. The rest of them were hospice (0.8%), left against medical advice (0.7%), and others (0.2%). Table 2 summarizes the results.

Table 2. Mortality and discharge disposition (N=2,286)

Variable	Categories	Freq (%)
Mortality	Live	2060 (90.1)
	Dead	226 (9.9)
Discharge disposition	Home	774 (33.9)
	Home Health Care	510 (22.3)
	Skilled Nursing Facility	295 (12.9)
	Rehabilitation hospital	254(11.1)
	Long term care hospital	95 (4.2)
	Transfer to hospital	94 (4.1)
	Hospice	18 (0.8)
	Left against medical advice	15 (0.7)
	Others	5 (0.2)
	Expired	226 (9.9)

The comorbid conditions were explored. Figure 1 illustrates the length of ICU and the number of comorbid conditions. Length of ICU stay varies proportionally with the number of diseases. Length of ICU stay was significantly correlated to the number of diseases ($r=.452$, $p<.001$)

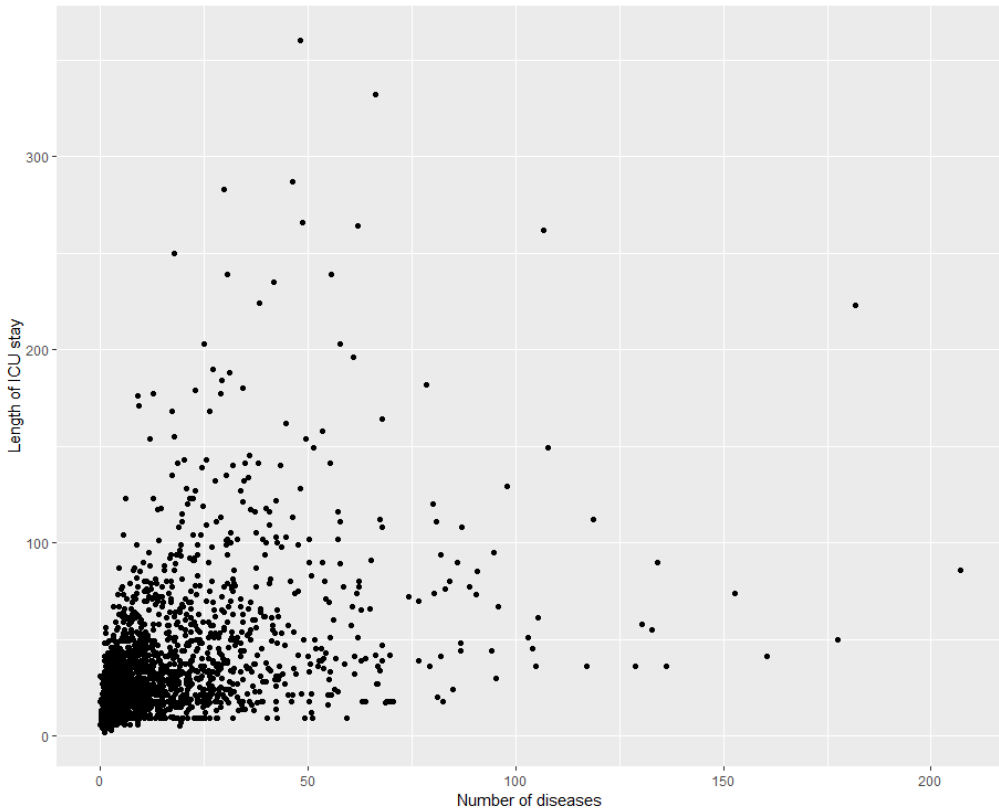

Figure 1. Length of ICU and number of comorbid conditions

The number of unique diseases in the patients with PI was 3,063 in total. The top five most frequently co-existing kinds of diseases was Hypertension, not otherwise specified (NOS), followed by congestive heart failure NOS, Acute kidney failure NOS, Acute respiratory failure, and Atrial fibrillation. Table 3 summarizes the top 10 diseases.

Table 3. Most frequently co-existing comorbid conditions (N=2,286)

ICD9 code	Title	Number of records (%)
4019	Hypertension NOS	927 (40.9)
4280	CHF NOS	915 (40.3)
5849	Acute kidney failure NOS	869 (38.3)
51881	Acute respiratory failure	826 (36.4)
42731	Atrial fibrillation	817 (36.0)
5990	Urinary tract infection NOS	798 (35.2)
99592	Severe sepsis	665 (29.3)
25000	DMII wo cmp nt st uncntr	603 (26.6)
41401	Crnry athrscl natve vssl	535 (23.6)
2859	Anemia NOS	492 (21.7)
2449	Hypothyroidism NOS	310 (13.7)

The number of patients with PI who have one or more procedures was 2,169 (94.9%). The number of unique procedures was 981. The top five most frequent procedure was ‘Venous catheterization, not elsewhere classified,’ followed by “Enteral infusion of concentrated nutritional substances,” “Insertion of endotracheal

tube," "Continuous invasive mechanical ventilation for 96 consecutive hours or more," and "Transfusion of packed cells."

Table 4. Top 10 most frequent procedures

ICD9 code	Title	Number of records (%)
3893	Venous catheterization, not elsewhere classified	1325 (58.0)
966	Enteral infusion of concentrated nutritional substances	945 (41.3)
9604	Insertion of endotracheal tube	844 (36.9)
9672	Continuous invasive mechanical ventilation for 96 consecutive hours or more	747 (32.7)
9904	Transfusion of packed cells	642 (28.1)
9671	Continuous invasive mechanical ventilation for less than 96 consecutive hours	654 (28.6)
3891	Arterial catheterization	463 (20.3)
9915	Parenteral infusion of concentrated nutritional substances	387 (16.9)
3995	Hemodialysis	366 (16.0)
3324	Closed [endoscopic] biopsy of bronchus	363 (15.9)

Length of ICU stay varies proportionally with the number of procedures. Figure 2 illustrates the length of ICU and the number of procedures done for the patients. Length of ICU stay was significantly correlated to the number of procedures (r=.729, p<.001).

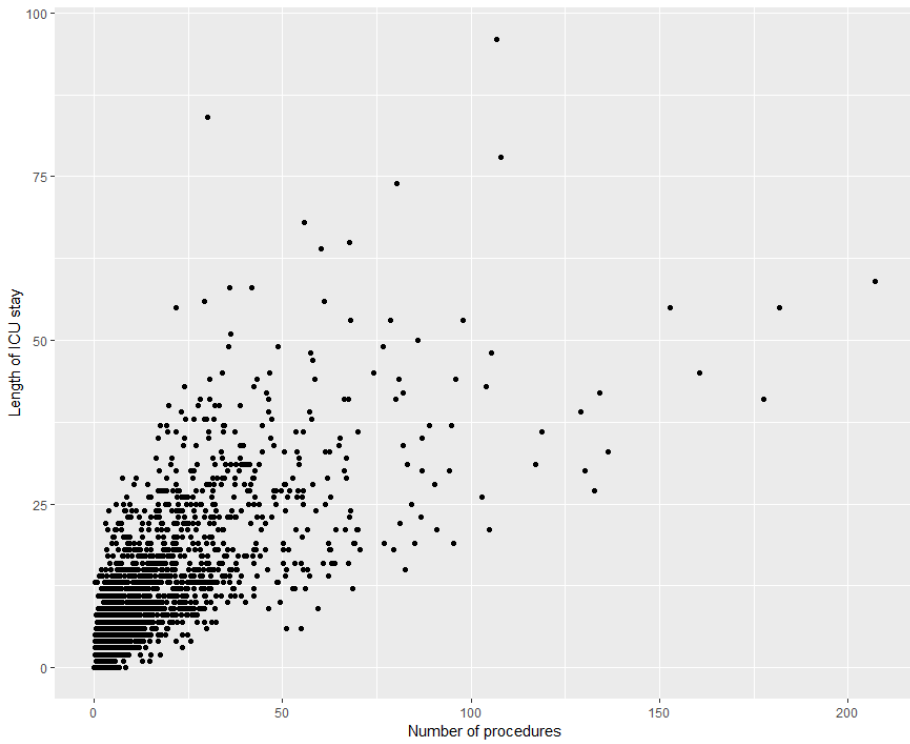

Figure 2. Length of ICU stay and number of procedures

4. Conclusion

Patient with a greater number of comorbid conditions were likely to have longer length of ICU stay. In addition, patient with a greater number of procedures that were performed during the admission were strongly

tend to stay longer in hospital. Thus, prospective studies focusing on comorbidity; and diagnostic and preventive procedures are needed in the prediction modeling of pressure injury development in ICU patients.

References

[1] The National Pressure Injury Advisory Panel. Secondary. https://npiap.com/page/2019Guideline
[2] S.O. Labeau, E. Afonso, J. Benbenishty, et al. Prevalence, associated factors and outcomes of pressure injuries in adult intensive care unit patients: the DecubICUs study. Intensive Care Med 2021;47(2):160-69. DOI:10.1007/s00134-020-06234-9
[3] C. Dealey, J. Posnett, A. Walker. The cost of pressure ulcers in the United Kingdom. J Wound Care 2012;21(6):261-2, 64, 66. DOI: 10.12968/jowc.2012.21.6.261
[4] K. Bauer, K. Rock, M. Nazzal, O. Jones, W. Qu. Pressure Ulcers in the United States' Inpatient Population From 2008 to 2012: Results of a Retrospective Nationwide Study. Ostomy Wound Manage 2016;62(11):30-38.
[5] L. Demarré, A. Van Lancker, A. Van Hecke, et al. The cost of prevention and treatment of pressure ulcers: A systematic review. Int J Nurs Stud 2015;52(11):1754-74. DOI: 10.1016/j.ijnurstu.2015.06.006
[6] S. Hyun, S. Moffatt-Bruce, C. Newton, B. Hixon, P. Pacharmon. Hospital-Acquired Pressure Injury: Clinical Characteristics and Outcomes in Critical Care. The International Journal of Advanced Culture Technology 2019;7(2):28-33. DOI: https://doi.org/10.17703/IJACT.2019.7.2.28
[7] D. Bly, M. Schallom, C. Sona, D. Klinkenberg. A Model of Pressure, Oxygenation, and Perfusion Risk Factors for Pressure Ulcers in the Intensive Care Unit. Am J Crit Care 2016;25(2):156-64. DOI: 10.4037/ajcc2016840
[8] J. Cox. Predictors of pressure ulcers in adult critical care patients. American Journal of Critical Care 2011;20(5):364-75. DOI: http://dx.doi.org/10.4037/ajcc2011934
[9] L. Goodman, E. Khemani, F. Cacao, et al. A comparison of hospital-acquired pressure injuries in intensive care and non-intensive care units: a multifaceted quality improvement initiative. BMJ Open Qual 2018;7(4). DOI: 10.1136/bmjoq-2018-000425
[10] Ö. Karayurt, Ö. Akyol, N. Kılıçaslan, et al. The incidence of pressure ulcer in patients on mechanical ventilation andeffects of selected risk factors on pressure ulcer development. Turk J Med Sci 2016;46(5):1314-22. DOI: 10.3906/sag-1504-139
[11] M. Lima Serrano, M. González Méndez, F. Carrasco Cebollero, J. Lima Rodríguez. Risk factors for pressure ulcer development in Intensive Care Units: A Systematic review. Med Intensiva 2017;41(6):339-46. DOI: 10.1016/j.medin.2016.09.003
[12] S. Hyun, S. Moffatt-Bruce, C. Cooper, B. Hixon, P. Kaewprag. Prediction Model for Hospital-Acquired Pressure Ulcer Development: Retrospective Cohort Study. JMIR Med Inform 2019;7(3):e13785. DOI: 10.2196/13785
[13] A. Johnson, T. Pollard, L. Shen, et al. MIMIC-III, a freely accessible critical care database. Scientific Data, 2016.
[14] AHRQ. Clinical Classifications Software (CCS) for ICD-10-PCS (beta version). Secondary Clinical Classifications Software (CCS) for ICD-10-PCS (beta version) Nov 5, 2019. https://www.hcup-us.ahrq.gov/toolssoftware/ccs10/ccs10.jsp.