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Review article

Perioperative medicine and Taiwan National Health Insurance Research Database

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ABSTRACT

"Big data", characterized by 'volume', 'velocity', 'variety', and 'veracity', being routinely collected in huge amounts of clinical and administrative healthcare-related data are becoming common and generating promising viewpoints for a better understanding of the complexity for medical situations. Taiwan National Health Insurance Research Database (NHIRD), one of large and comprehensive nationwide population reimbursement databases in the world, provides the strength of sample size avoiding selection and participation bias. Abundant with the demographics, clinical diagnoses, and capable of linking diverse laboratory and imaging information allowing for integrated analysis, NHIRD studies could inform us of the incidence, prevalence, managements, correlations and associations of clinical outcomes and diseases, under the universal coverage of healthcare used. Perioperative medicine has emerged as an important clinical research field over the past decade, moving the categorization of the specialty of "Anesthesiology and Perioperative Medicine". Many studies concerning perioperative medicine based on retrospective cohort analyses have been published in the top-ranked journal, but studies utilizing Taiwan NHIRD were still not fully visualized. As the prominent growth curve of NHIRD studies, we have contributed the studies covering surgical adverse outcomes, trauma, stroke, diabetes, and healthcare inequality, etc., to this ever growing field for the past five years. It will definitely become a trend of research using Taiwan NHIRD and contributing to the progress of perioperative medicine with the recruitment of devotion from more research groups and become a famous doctrine.

Our world is experiencing a data-driven transformation. The paradigm 'big data' has caused overwhelming attention in many areas recently. Characterized by 'volume', 'velocity', and 'variety', and even with 'veracity', the routinely collected huge amounts of clinical and administrative health-related data are becoming more common, and generating promising viewpoints for a better understanding of complexity for medical situations. Equipped with these new and powerful information technologies, we are not only acknowledging biomedical findings, but also rapidly converting the practice of medicine into science of information technology.[1] The cumulative numbers of epidemiologic studies using public electronic health database in Canada, France and Germany, published between 1995 and 2009, were fitted well with a power growth model in a recent study.[2]

Large sized, population-based researches could inform us of the incidence, prevalence, managements, correlations and associations of diseases, in addition to the patterns of health care used. Studies sampling the whole population of an entire country make up of a unique type of large population studies. The strength of this special type of studies includes big sample size and avoiding of selection and participation bias.[3] Taiwan National Health Insurance Research Database (NHIRD), ranked as one of the largest nationwide population databases in the world, covers almost 23 million residents in Taiwan with universal coverage.[4,5] With the databases abundant with the demographic, clinical, and covariate information, and capable of linking diverse information allowing for integrated analysis, the strength of NHIRD studies is enhanced further.[3] Large sample size, longitudinal study design, and complete records of medical visits and treatment are strength of NHIRD. However, there are some study limitations in it including lack of information of

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detailed socio-economic status, results of examinations (such as biochemical measures, X-ray, CT-scan, MRI, et etc.), clinical risk score, and lifestyle. The interesting topic, better study design, and adequately addressing the study limitations may eliminate the challenge of submitting the NHIRD-related manuscripts to international scientific journals.

According to the records of Taiwan's National Health Research Institutes, there are 3560 successful applications for NHIRD between 2003 and 2015. After searching Pubmed website in July 15, 2016, there are nearly 4000 published articles related to NHIRD and 143 of them were surgery-related articles that included gastroenterological surgery (n = 27), major unclassified surgery (n = 27), musculoskeletal surgery (n = 19), cardiovascular surgery (n = 15), gynecological surgery (n = 15), urinary surgery (n = 15), ophthalmological surgery (n = 9), otorhinolaryngological surgery (n = 6), neurosurgery (n = 4), thoracic surgery (n = 4), and bariatric surgery (n = 2). These surgery-related articles were announced from 2004 to 2016 and more than 95% of them were published in the international scientific journals. Over the first decade after NHIRD release, the productivity of NHIRD studies was rapidly accelerating with an average annual growth rate of 45.8%,6 which was significantly higher than all PubMed literature growth of 17% between 2002 and 2006.[7] The NHIRD studies had not only grown rapidly in numbers only, but also in quality. The vast majority (92.2%) of the NHIRD studies were indexed in the Science Citation Index 2008 at the end of 2009, with several outstanding articles published in top ranking journals thereafter.[8–10] Furthermore, it took barely 2.49 years to double the number of SCI indexed NHIRD studies, and the numbers of authors, journals and study fields also doubled every two years,[6] rendering NHIRD one of the most impactful source of biomedical studies.

According to Wikipedia, "*The term perioperative medicine describes the medical care of patients from the time of contemplation of surgery through the operative period to full recovery, but excludes the operation or procedure itself.*"[11] Over the past decades, perioperative medicine has also emerged as an important clinical and research field.[12] With the expansion of anesthesiologists' clinical footprints outside operation rooms, which is consonant with the progresses that have taken place in other medical fields, it has even been suggested that the specialty of "Anesthesiology" be renamed to the specialty of "Anesthesiology and Perioperative Medicine".[13] However, even though many studies concerning perioperative medicine basing on retrospective data analysis had been published in high impact journals,[14–16] few studies utilizing NHIRD had been available from these high ranking academic periodicals. Estimated from the aforementioned growth curve of NHIRD studies,[6] we believe that there are opportunities and responsibilities for us to better contribute to this ever growing field by the use of NHIRD.

Since the year 2009, we started to focus NHIRD studies in perioperative medicine and other fields of medical interests. All these publications could be organized into four main categories. First, the surgical morbidities and mortalities among medically vulnerable patients were focused when they received major surgeries. Using specially requested datasets from NHIRD, focusing on major surgeries under general anesthesia, patients with old ages,[17] intellectual disabilities,[18] epilepsy,[19] dementia,[20] schizophrenia,[21] immune thrombocytopenia,[22] systemic lupus erythematosus,[23] hemodialysis,[24] diabetes,[25] and liver cirrhosis[26] were evaluated for postoperative adverse effects. While all the patient groups experienced increased odds of postoperative acute renal failure, pneumonia, and septicemia, increased risks of 30-day postoperative mortality were noted in patients with dementia, schizophrenia, immune thrombocytopenia, systemic lupus erythematosus, hemodialysis, diabetes, and liver cirrhosis (Table 1). Second, the traumatic brain injury (TBI) related perioperative medicine. In this series of studies, mental disorders,[27] previous stroke,[28] and socioeconomic status in children[29] were newly identified as contributing risk factors for TBI. On the other hand, a previous history of TBI might increase post-stroke mortality on new onset stoke patients.[30] Patients with TBI were associated with increased risk of epilepsy,[31] while acupuncture use in this population was noted to decrease the risk of post-TBI stroke,[32] and reduced use of emergency care and hospitalization.[33] Thirdly, in the stroke-related studies, hepatitis C virus infection was firstly identified as an independent risk factor for stroke,[34] whilst uvulo-palato-pharyngoplasty (UPPP) was demonstrated to

Table 1
Summary of Research in Postoperative Surgical Morbidities and Mortality. Data expressed as Odds Ratio (95% Confidence Interval). ITP stands for immune thrombocytopenia; SLE, systemic lupus erythematosus.

Patient Groups (*Published Journals*)	Elderly (≥85 vs 55~64) (*Am J Manag Care.*)	Intellectual disability (*PLoS One.*)	Epilepsy (*Epilepsia.*)	Dementia (*World J Surg.*)	Schizophrenia (*Ann Surg.*)
Postoperative 30-day mortality		1.52 (0.91–2.54)	[1.06 (0.87–1.29)]	1.56 (1.36–1.78)	2.70 (2.08–3.49)
Postoperative complications					
Acute myocardial infarction	1.91 (1.67–2.19)			0.97 (0.82–1.14)	0.87 (0.36–2.13)
Acute renal failure	4.38 (4.03–4.77)	3.81 (2.28–6.37)	1.61 (1.32–1.97)	1.55 (1.39–1.73)	3.92 (2.25–6.81)
Deep wound infection	0.75 (0.65–0.87)	1.32 (0.91–1.90)	1.31 (1.04–1.66)	0.87 (0.70–1.08)	1.13 (0.72–1.76)
Pneumonia	5.21 (4.98–5.45)	2.01 (1.61–2.49)	2.54 (2.32–2.79)	2.44 (2.31–2.58)	2.99 (2.33–3.83)
Pulmonary embolism	0.80 (0.75–0.86)			0.99 (0.65–1.50)	1.05 (0.22–5.04)
Postoperative bleeding	2.17 (1.57–3.01)	1.35 (1.09–1.68)	1.14 (1.02–1.29)	0.98 (0.89–1.09)	1.27 (1.05–1.54)
Septicemia	4.35 (4.13–4.58)	2.43 (1.85–3.21)	2.03 (1.83–2.26)	2.02 (1.90–2.15)	2.83 (2.06–3.87)
Stroke	2.03 (1.95–2.11)	1.18 (1.35–1.73)	3.15 (2.76–3.59)	1.66 (1.57–1.75)	1.39 (1.18–1.64)
Any of the above	2.74 (2.67–2.82)	1.53 (1.35–1.73)	2.02 (1.90–2.14)	1.93 (1.86–2.00)	1.57 (1.42–1.75)
Patient Groups (*Published Journals*)	ITP (*Br J Surg.*)	SLE (*Ann Rheum Dis.*)	Dialysis (*PLoS One.*)	Diabetes (*Diabetes Care.*)	Liver Cirrhosis (*Br J Surg.*)
Postoperative 30-day mortality	1.89 (1.57–2.27)	1.71 (1.09–2.67)	3.33 (2.56–4.33)	1.84 (1.46–2.32)	1.88 (1.63–2.16)
Postoperative complications					
Acute myocardial infarction	0.75 (0.57–0.98)	1.12 (0.56–2.24)	1.85 (1.35–2.54)	3.65 (2.43–5.49)	0.64 (0.50–0.82)
Acute renal failure	2.06 (1.74–2.44)	2.90 (2.01–4.17)		3.59 (2.88–4.48)	1.52 (1.34–1.74)
Deep wound infection	1.18 (0.92–1.51)	0.53 (0.30–0.93)	0.62 (0.43–0.89)	1.33 (1.04–1.70)	1.19 (1.02–1.39)
Pneumonia	1.57 (1.42–1.74)	1.31 (1.01–1.70)	1.70 (1.49–1.94)	1.88 (1.65–2.14)	1.12 (1.03–1.22)
Pulmonary embolism	1.21 (0.67–2.19)	2.76 (0.94–8.13)			1.01 (0.59–1.74)
Postoperative bleeding	1.25 (1.12–1.39)	0.94 (0.69–1.29)	1.40 (1.21–1.63)		1.18 (1.06–1.32)
Septicemia	2.01 (1.84–2.22)	1.75 (1.38–2.21)	2.83 (2.50–3.20)	2.76 (2.50–3.04)	1.42 (1.33–1.51)
Stroke	1.09 (0.98–1.21)	0.98 (0.76–1.28)	0.94 (0.83–1.06)	1.70 (1.49–1.94)	0.92 (0.85–1.00)
Any of the above	1.47 (1.39–1.56)	1.29 (1.13–1.47)	1.70 (1.58–1.84)	2.42 (2.26–2.60)	1.22 (1.16–1.27)