Proceedings of the 2019 Winter Simulation Conference
N. Mustafee, K.-H.G. Bae, S. Lazarova-Molnar, M. Rabe, C. Szabo, P. Haas, and Y.-J. Son, eds.

SIMULATION BASED OPTIMIZATION FOR TROMBOLISYS RATE MANAGEMENT OVER ISQUEMIC CEREBRO VASCULAR ACCIDENTS

Ricardo Carreño

Department of Industrial Engineering
Universidad Andres Bello
Av Antonio Varas 880, Providencia
Santiago, 7500971, CHILE

Luis F. Robledo

Science Engineering Department
Universidad Andres Bello
Av Antonio Varas 880, Providencia
Santiago, 7500971, CHILE

Edgardo Villavicencio

El Pino Hospital
Av Padre Hurtado 13560, San Bernardo
Santiago, 8011871, CHILE

ABSTRACT

Cerebrovascular accidents (CVA) are the main cause of death in Chile. Despite an effective procedure in existence (Thrombolysis), CVA rate for patients that received treatment fluctuates between 3 and 5%. Thrombolysis allow a time window of 4.5 hrs. for treatment effectiveness to avoid serious damage provoked by CVA. A low thrombolysis rate is a result of this time window and is considered the main reason for drug administration exclusion. For this, we identified the factors that affect patients to get proper treatment. To identify these factors, we have divided the process in pre and post-admission. Following a survey of patients affected by CVA, we preliminary identified pre-admission factors in El Pino Hospital (EPH), while for post-admission patients we followed an in-hospital simulation modeling process in EPH. The identification of these factors should allow us to increase thrombolysis rate for patients affected by a CVA.

1 INTRODUCTION

In Chile, CVA is one of the most important problems in public health with an incidence of 130 out of 100.000 inhabitants per year (Lavados et al. 2007). CVA is considered the main cause of death for the last 10 years, reaching a 7.94% in 2014. There is an effective treatment for this pathology called intravenous thrombolysis (IVT) that allows reestablishment of blood flow, dissolving the obstruction of compromised vessels. Administration of this drug provides a time span between 3 to 4.5 hrs. since first symptoms appeared. Most efforts to reduce mortality or serious sequels has centered in minimizing the time from entry to drug provision, however, an annual rate of 3.8% of thrombolyzed patients is the average rate.

2 TIME IS BRAIN

Time window for thrombolysis is the main cause of exclusion for drug administration to patients under CVA. Studies have shown that drug administration for thrombolysis after 4.5 hrs. may present bigger risks than benefits (Lees et al. 2010). For this reason it is required to act fast in order to avoid physical and psychological sequels, as these sequels provide long term negative effects in patients' quality of life, affecting not only the individual but the family circle, emotionally and economically. While specific time is provided for thrombolysis drug administration, patients face a series of limitations that prevent an effective treatment. Literature classifies these limitations as pre and post-admission barriers, concluding

that among all CVA patients, nearly 35% of them made it between 4 and 5 hrs. while the amount of patients that made the time window reached only 3% to overcome post-admission barriers and get the proper thrombolysis treatment.

3 MODELING BARRIERS FOR CVA THROMBOLYSIS TREATMENT

EPH is a high complexity public health institution. It provides emergency, specialist and hospitalization services. For CVA patients, EPH uses Telemedicine with neurologists from other health facilities. The use of telemedicine provides immediate attention to CVA patients when arriving to EPH emergency room. Despite the advantage of having this communication procedure, thrombolysis rate for CVA patients hasn't had a significant improvement. As a way to know why people don't receive thrombolysis treatment on time, we identified barriers of attention in two stages: Pre and Post-admission.

Pre-Admission barriers for a CVA patient may have several causes such as a failure or null identification of symptoms, patient showing up to in health care facilities with no neurology service, ambulance delays and diagnosis accuracy failures (Engelter et al. 2007). To identify these factors we followed a survey to patients with CVA and their relatives. These surveys are still ongoing as data is scarce. Hospital digital files also provides substantial data for this purpose.

Post-Admission barriers deal with patients that have been admitted. The main difference with the aforementioned process is that they are being modeled following the process shown on Figure 1. At the meantime, these factors are being simulated including telemedicine and current EPH process times. Modeling and simulation allows identification of slow and non-efficient processes which delay patients' urgent care. Once identified all suitable factors with statistical significant results, they should provide the basis for optimizing parameters resulting in a following increment in thrombolysis rate for CVA patients.

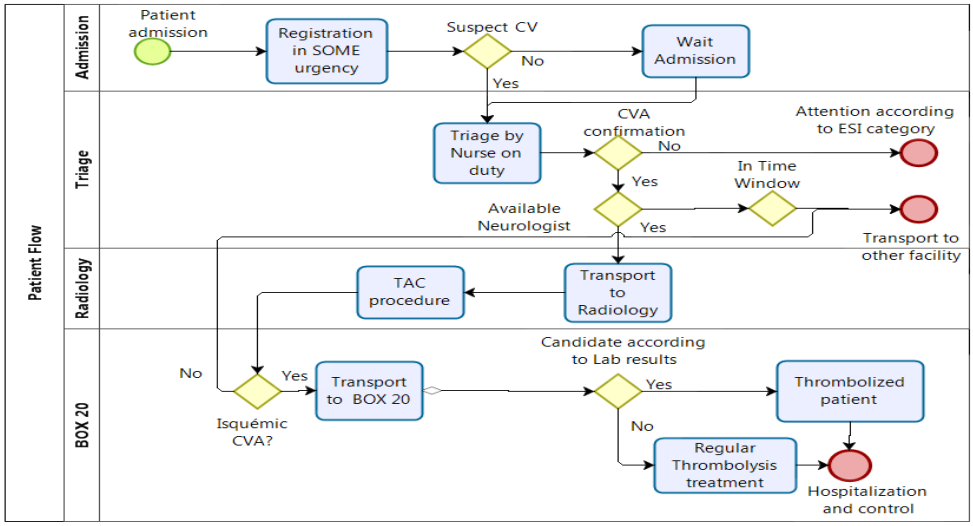

Figure 1: Patient flow modeling.

REFERENCES

Engelter, S. T., M. Gostynski, S. Papa, V. Ajdacic-Gross, and P. A. Lyrer. 2007. "Barriers to stroke thrombolysis in a geographically defined population". *Cerebrovascular Diseases* 23(2–3): 211–215.

Lavados, P. M., C. Sacks, L. Prina, A. Escobar, C. Tossi, and L. Araya. 2007. "Incidence, case-fatality rate, and prognosis of ischaemic stroke subtypes in a predominantly Hispanic-Mestizo population in Iquique, Chile (PISCIS project): a community-based incidence study¨. *Lancet Neurology*, 6(2), 140–148.

Lees, K. R., E. Bluhmki, R. Von Kummer, T.G. Brott, D. Toni, J.C. Grotta, and W. Hacke. 2010. "Time to treatment with intravenous alteplase and outcome in stroke: an updated pooled analysis of ECASS, ATLANTIS, NINDS, and EPITHET trials". *The Lancet*, 375(9727), 1695–1703.