The Impact of Machine Learning Algorithms on Benchmarking Process in Healthcare Service Delivery

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Abstract

In the United States, federal law requires that hospital emergency departments (EDs) are to provide care to all patients, regardless of patient's ability to pay. This has caused the emergency rooms to be stretched beyond their capacity which adversely affects the quality of care rendered to patients. To improve the quality of health care service provided in the EDs, hospital management has adopted benchmarking (BM) which is a quality improvement tool for performance measurement and efficiency analysis of the EDs. This study utilizes a structured BM model which consists of planning, analysis, integration, and action phases. Data envelopment analysis (DEA), which is a non-parametric technique for estimating the efficiency of a given set of decision-making units (DMUs) and Back-propagation neural network (BPNN), a supervised learning algorithm for training neural networks is incorporated into the analysis phase of benchmarking as a performance prediction tool. Results from the BP-DEA model shows that fifty percent of the DMUs are efficient while the remaining fifty percent is relatively inefficient. Areas of potential improvement in the less-efficient departments are investigated. Implementing recommendations from the analysis can lead to increased quality of healthcare services provided to patients and increased efficiency in hospital operations.

Keywords
Benchmarking, Quality Improvement, Emergency Department, Data Envelopment Analysis, Neural Network

Biography / Biographies

Egbe-Etu Etu is a PhD candidate in the department of Industrial & Systems Engineering at Wayne State University. He is involved with research areas in data analytics and decision making in product development, and service sectors. He is an active student member of SAVE International and Institute of Industrial & Systems Engineering.

Celestine Aguwa is currently at Wayne State University as an Associate Professor Research involved with research and teaching graduate courses in Industrial and Systems Engineering. His background includes lean and value methodology in product development and advanced manufacturing; voice of the customer analysis in product recalls; decision analysis modeling. He is currently working on several research projects in data analytics which has resulted in several proposals, some of which are NSF and industry funded research projects. He is in collaboration with other faculty working on NSF sponsored research on curriculum development among others. He has a cross functional industrial experience at Ford Motor Company and extensive professional experience as an Architect. Dr. Aguwa has a Ph.D. and MSIE in Industrial and Manufacturing Engineering from University of Pittsburgh and Massachusetts, Amherst, respectively. He also has a B.Arch. degree in Architecture from University of Nigeria. Dr. Aguwa has several awards, including a patent, and has written several published papers. He is a member of the Institute of Industrial and Systems Engineers, SAVE International, INFORMS, Alpha Pi Mu National Industrial Engineering Honor Society, and Beta Sigma Fraternity, International.

Leslie Monplaisir is a Professor and Chair of the Department of Industrial and Systems Engineering at Wayne State University. He is the Lead Researcher and Director of the Product Development and Systems Engineering Consortium (PDSEC) at WSU. His research interests include: Lean Product Development, Design for lean Systems and Services and Design reuse, New Product Technology Decision modeling, Product Architecture Optimization, Design for Supply Chain, Global Product Platform Optimization and Healthcare Technology System Design He has authored over 100 publications in these areas with funded research from NSF, Veterans Administration and Ford Motor Company. Dr. Monplaisir joined the College of Engineering at Wayne State University in the Department of Industrial and Manufacturing Engineering in 1996 from Florida A & M University where he was a visiting assistant professor. He earned his Ph.D. in Engineering Management from the Missouri University of Science and Technology (MUST), a master's in Computer Integrated Manufacturing from the University of Birmingham in Great Britain.

Suzan Arslanturk is an Assistant Professor in the department of Computer Science at Wayne State University. She was formerly an assistant professor at Ozyegin University in Istanbul, Turkey. She also worked as a research scientist for a healthcare consulting company in Michigan while completing her Ph.D. at Oakland University in 2015. From 2011 to 2014 she was a research scholar at the OU Biomedical Engineering Lab. Her research interests are in the area of data mining and predictive modeling with applications in healthcare.

Joseph Miller is an Emergency Medicine Physician at Henry Ford Hospital. He specializes in Emergency Medicine, Internal Medicine and Clinical Research. Dr. Miller's research interest is focused on emergency neurological conditions such as acute stroke, epilepsy, and traumatic brain injury. He also does research in hypertensive emergencies and teach research methodology within the health system.