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Alfred A. Cecchetti

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Why Introduce Machine Learning To Rural Health Care?

Alfred A. Cecchetti PhD, MSc\textsuperscript{1}

**Author Affiliations:**

1. Marshall University, Huntington, West Virginia

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**Corresponding Author:**

Alfred A. Cecchetti PhD
Marshall University
Huntington, WV
Email: cecchetti@marshall.edu
Why Introduce Machine Learning To Rural Health Care?

Machine learning, the process of teaching a machine to recognize patterns without explicitly being programmed, can utilize existing clinical data sets to detect patterns and trends and predict future medical outcome/events, thereby, giving us the ability to proactively influence patient health. It especially lends itself to those areas of healthcare that have reproducible or standardized processes such as care management.

Machine leaning has three primary categories: supervised learning, unsupervised learning, and reinforcement learning. Supervised learning uses an expert (e.g., someone who has a strong understanding of that field) to label medical data with an outcome. The produced model then learns the relationship between the data and the outcome to produce future prediction on new data. Unsupervised learning does not use an expert to label its data with an outcome, but develops a model that sorts and separates that data into groups. The unsupervised model then can separate new data set into groups of its choice. Reinforcement learning uses trial and error to figure out an optimal goal. In this model, the training data are expected to provide only an indication as to whether an action is correct or not. An evaluation process on the above machine learning categories to determine how “correct” the developed models are can then be introduced and assessed.

Rural Disparities

Disparities exist in the health care system; rural populations show higher rates of chronic illness and poorer overall health.\(^1\,2\,3\,4\,5\) Rural health has not received the same attention as the health problems found in the urban population.

The Centers for Disease Control and Prevention list the top ten causes of death in West Virginia in the following order: heart disease, cancer, accidents, chronic lower respiratory diseases, stroke, diabetes, alzheimer’s disease, kidney disease, pneumonia, and suicide.\(^6\) For each of these causes of death a machine learning algorithm has been designed to predict outcomes: heart disease\(^7\,8\), cancer\(^9\,10\), accidents\(^11\,12\), respiratory disease\(^13\,14\), stroke\(^15\,16\), diabetes\(^17\,18\), alzheimer’s disease\(^19\,20\), kidney disease\(^21\,22\), pneumonia\(^23\,24\), and suicide\(^25\,26\). Machine learning can also help rural health in disease identification and management, diagnosis (especially when “diagnosis of elimination” is required), personalized medicine, behavioral issues, clinical trial research, radiology, radiotherapy, and epidemic outbreak prediction.

Machine learning has the potential to focus its predictive power on fast classification or even on prevention of rural health disparities at low cost and high speed.

Why focus on the Rural Population?

A look at rural populations shows that this group has special problems due to a higher mix of older individuals who have lower financial resources, educational deficiencies, and tendency to be more ill than urban populations.\(^27\) The physician to patients ratio is typically very inadequate in rural areas resulting in long and in many cases arduous travel distances to obtain health services, long wait times for appointments, and limited access to certain specialists within the rural geographic areas.
Rural populations can benefit in a number of ways by machine learning. Those medical specialties that use images (cardiology, radiology, pathology) can, through the use of machine learning algorithms, provide faster and cheaper services without the need for high cost specialists who can now spend more time dealing directly with their patients. Machine learning is already showing signs of promise using experimental novel techniques in mental healthcare. For instance, in the detection of changes in mental states for bipolar patients in a rural psychiatric hospital in Austria, a machine learning app for depression/mania recognition produced an accuracy of 72–81%.[28] This is very promising for rural populations, since these machine-learning approaches suggest that the ability to diagnosis dangerous medical conditions without the need to have a local and expensive specialized healthcare provider nearby is possible.

**Machine Learning Obstacles**

There are difficulties, as well, associated with the use of machine learning methods especially in the rural areas. Some methods use “black box” approaches where the actual reasoning of the model is difficult to discern. Data silos can be difficult to overcome. Technical support is often limited with few resources to allocate to this area. In urban areas, stricter controls on the insertion of data in the electronic medical records can be enforced. Rural areas tend to have less control on this process. Another major concern is bias (cultural, educational, gender, race, location, etc.) in the development of these algorithms. Regional differences found within the supervised machine learning models may need to be better understood to improve accuracy within these rural models.

**The Future of Machine Learning in Rural Health Care**

Using advanced analytics, algorithms can assist rural medical providers by providing better information at lower cost. They have the potential to open the floodgates to the combined brainpower and expertise of the best top-notch healthcare providers and organizations for the rural population and thus provide them access to the best care they can get.

Machine learning and the associated algorithms they produce can be another powerful tool in the rural health care provider’s toolbox to understand and predict disease and other medical events while lowering the cost of receiving these services.
References