Methods for measuring and recommending efficiencies in preventive health care powered by AI

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Summary

The concept of health system efficiency may seem beguilingly simple, represented at its simplest as a ratio of resources consumed (health system inputs) to some measure of the valued health system outputs that they create. In effect, this creates a metric of the generic type, the so-called resource use per unit of health system output. Yet, making this straightforward notion operational can give rise to considerable complexity. Within the health system as a whole, there exist a seemingly infinite set of interlinked processes that could be evaluated independently and found to be efficient or inefficient. This has given rise to a plethora of apparently disconnected indicators that give glimpses of certain aspects of inefficiency, but rarely offer a comprehensive overview.

Efficiency evaluation is one task under the broader, multidimensional approach to performance assessment and is undertaken subject to the achievement of other service goals.

Efficiency is one facet of the overall performance of health services.

Artificial intelligence (AI) aims to mimic human cognitive functions. It is bringing a paradigm shift to healthcare, powered by increasing availability of healthcare data and rapid progress of analytics techniques. We survey the current status of AI applications in healthcare and discuss its future. AI can be applied to various types of healthcare data (structured and unstructured). Popular AI techniques include machine learning methods for structured data, such as the classical support vector machine and neural network, and the modern deep learning, as well as natural language processing for unstructured data. Major disease areas that use AI tools include cancer, neurology and cardiology. We then review in more details the AI applications in stroke, in the three major areas of early detection and diagnosis, treatment, as well as outcome prediction and prognosis evaluation. We conclude with discussion about pioneer AI systems, such as IBM Watson, and hurdles for real-life deployment of AI.

Specific Aims

Aims to provide some insight into the conceptual and methodological issues in measuring efficiency in health services. For researchers engaged in efficiency analysis, it is a précis of measurement techniques and applications. • For those who have responsibility for health expenditure decisions or policy advice, it points to the appropriate analytical tools and necessary data for measuring efficiency.

Personal issues which impacted very well drawing me to solve it.

Investigate the state of knowledge about efficiency measurement in the health sector, both in Canada and abroad; • show how features specific to health and health services affect the suitable methodology for measuring efficiency; and • subject to the use of appropriate evaluation methods, point to areas where better data and modelling are needed to enhance efficiency analysis.

Background and Significance

The significance of AI have been extensively discussed in the medical literature. AI can use sophisticated algorithms to ‘learn’ features from a large volume of healthcare data, and then use the obtained insights to assist clinical practice. It can also be equipped with learning and self-correcting abilities to improve its accuracy based on feedback. An AI system can assist physicians by providing up-to-date medical information from journals, textbooks and clinical practices to inform proper patient care. In addition, an AI system can help to reduce diagnostic and therapeutic errors that are inevitable in the human clinical practice. Moreover, an AI system extracts useful information from a large patient population to assist making real-time inferences for health risk alert and health outcome prediction.

Experimental Design and Methods

The above discussion suggests that AI devices mainly fall into two major categories. The first category includes machine learning (ML) techniques that analyse structured data such as imaging, genetic and EP data. In the medical applications, the ML procedures attempt to cluster patients’ traits, or infer the probability of the disease outcomes. The second category includes natural language processing (NLP) methods that extract information from unstructured data such as clinical notes/medical journals to supplement and enrich structured medical data. The NLP procedures target at turning texts to machine-readable structured data, which can then be analysed by ML techniques.

For better presentation, the flow chart in describes the road map from clinical data generation, through NLP data enrichment and ML data analysis, to clinical decision making. We comment that the road map starts and ends with clinical activities. As powerful as AI techniques can be, they have to be motivated by clinical problems and be applied to assist clinical practice in the end.

The production process in hospital care Costs Physical inputs Physical outputs Activities Outcome Capital; Labour; Drugs Diagnostic tests; Surgical procedure Episode of hospital care Improvement in length & quality of life Patient experience E.g. average wages E.g. tests per histologist per month E.g. average length of stay E.g. risk adjust mortality rate E.g. cost per QALY Note: QALY = quality-adjusted life year.

References

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