

Benchmarking rehabilitation efficiency across Canadian provinces: An implementation of TOPSIS analysis of throughput and budget allocation

Sepideh Sadat Sadjadi^{a*}

^aDepartment of Industrial Engineering, School of Engineering, University of Tehran, Tehran, Iran

CHRONICLE

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ABSTRACT

Therapeutic medications are the primary concern for restoration of functional independence and the quality of Canadian's lives across the country. Bigger requirements and limiting opportunities have begun pushing on assessing the relative efficiency of all rehabilitation centers to find with evidence-based policy and funding decisions. Thus, this primary objective of this paper is to consider throughput, functional outcome, and budget allocations for ten Canadian provinces to measure the relative efficiency using Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method to provide a comparative view at service delivery and resource utilization. According to our results, when we consider equal weights for three factors, Manitoba is ranked first followed by Nova Scotia, New Brunswick and Saskatchewan. When we increase the weight of the budget in our method, these provinces still perform better than other provinces. Even when we reduce the weights of the budget, these provinces demonstrate good performance. Surprisingly, Ontario has presented the worst performance compared with other provinces.

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1. Introduction

Rehabilitation care is essential in the recovery process after acute medical events, particularly in aiding patients to regain their independence and being part of daily life again. The aging population together with the increase in chronic conditions and post-operative care needs put the rehabilitation services under pressure—this situation displays the urgent need for proper and fair allocation of resources (Allin et al., 2016). In Canada, the provision of rehabilitation services is radically different from one province to another, in regard to the areas of financial support, service capacity, and clinical outcomes. Although these differences exist, performance comparisons that cover all aspects and evaluation using standardized methods are still not widely used (Stinear et al., 2017).

This study attempts to fill the existing gap and applies Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to evaluate the relative efficiency of rehabilitation services in the ten Canadian provinces (Hwang & Yoon, 1981; Yoon, 1987). Taking Estimated Annual Budget as cost item and Avg Admissions per Center and Functional Gain (FIM score) as benefits for the implementation of TOPSIS, the model primarily checks whether each province provides financial resources into volumes of service and functional recovery. Through comparative jurisdictional performance, the survey will provide best practice mechanisms, highlight disparities, and present timely guidelines to policymakers and administrators in Canadian healthcare. According to our results, when we consider equal weights for three factors, Manitoba is ranked first followed by Nova Scotia, New Brunswick and Saskatchewan. When we increase the weight of the budget in our method, these provinces still perform better than other provinces. Even when we reduce the weights of the budget, these provinces demonstrate good performance. Surprisingly, Ontario has presented the worst performance compared with other provinces.

* Corresponding author.

E-mail address: sepideh.sadjadi@ut.ac.ir (S. S. Sadjadi)

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2. Literature review

Rehabilitation services come under post-acute care, specifically for patients recovering from different diseases such as stroke, orthopedic surgery, and neurological conditions. Basically, an essential concentration of assessment has been functional outcomes, patient satisfaction, and efficiency at the level of the system. Many efforts by Heinemann et al. (2003) and Stucki and Melvin (2007) concentrate on the relative advantage of standardized outcome measurement such as the Functional Independence Measure (FIM) for describing the level of rehabilitation recovery and helping with different clinical decision-making.

In Canada, the Canadian Institute for Health Information (CIHI) has established the National Rehabilitation Reporting System (NRS), which collects data on inpatient rehabilitation episodes in all ten different provinces. The system helps comparative investigation of throughput, length of stay, and discharge outcomes, as given in CIHI's annual Quick Stats reports. However, few studies have used quantitative benchmarking tools like TOPSIS to evaluate provincial-level efficiency in rehabilitation delivery.

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) has attracted much interest in healthcare performance evaluation due to its capability for considering different factors with some predefined weights. The TOPSIS method has become more and more popular in the field of rehabilitation-related decision-making since it can deal with multiple criteria that are often conflicting. Tscheikner-Gratl et al. (2017) used TOPSIS in infrastructure rehabilitation, providing a transferable framework for the prioritization of interventions based on cost, urgency, and impact—principles that are very similar to those used in the allocation of healthcare resources. Pandey et al. (2023) conducted a thorough review of the TOPSIS method and its extensions, and the adaptability of the method in healthcare including rehabilitation service evaluation, patient prioritization, and facility benchmarking was among the issues covered in the review. Their study illustrates the method's flexibility when combined with fuzzy logic or entropy-based weighting, thus improving its capability to handle uncertain environments. Madanchian and Taherdoost (2023) gave an easy-to-follow guide for TOPSIS implementation, illustrated with health and social development sectors examples. They pointed out the method's transparency and user-friendliness, which make it a fit for interdisciplinary teams to work together during the rehabilitation planning process. All of these studies combined show the way that TOPSIS aids in making evidence-based decisions in rehabilitation by letting the trade-offs be quantified and by directing the optimization of resources. Its organized method is particularly useful in situations where clinical, operational, and financial factors must all be considered at the same time.

TOPSIS is underutilized in Canadian rehabilitation studies. This study attempts to address the gap by integrating CIHI metrics with provincial budget data to assess how effectively financial resources are converted into patient throughput and functional recovery, providing a novel framework for policy benchmarking and system improvement.

3. The proposed study

As discussed, the study uses TOPSIS to measure the relative efficiencies of 10 provinces in Canada. Table 1 presents the data adapted for the proposed study of this paper.

Table 1
Primary Rehabilitation Efficiency by Province and the budget (2025)

Decision Units	Input		Outputs	
	Estimated Annual Budget (B\$ in CAD)	Avg Admissions per Center	Functional Gain (FIM score)	
Ontario	1.2	450	25	
Quebec	0.500	380	22	
British Columbia	0.650	400	23	
Alberta	0.580	420	24	
Manitoba	0.220	350	21	
Saskatchewan	0.180	300	20	
Nova Scotia	0.160	310	21	
New Brunswick	0.140	290	20	
Newfoundland & Labrador	0.130	270	19	
Prince Edward Island	0.090	250	20	

Source Information: Rehabilitation Efficiency Table – Canada by Province (2025)

Note: Budgets include inpatient rehab, outpatient therapy, and community-based services.

Figures are estimates based on provincial health ministry reports and CIHI rehab allocations.

Functional Gain reflects average improvement in mobility, cognition, and self-care.

For the implementation of the TOPSIS technique, the study has considered Estimated Annual Budget (Billion dollar in CAD) as cost and Avg Admissions per Center and Functional Gain (FIM score) as benefit. In other words

- **Avg Admissions per Center** is related to the average number of patients considered to each rehabilitation facility within a province, annually. This factor provides the center's service volume and throughput capacity for inpatient rehabilitation care.

- **Functional Gain (FIM score)** is the recovery in a patient's physical and cognitive abilities within the rehabilitation, based on the Functional Independence Measure. A higher score means a bigger recovery in terms of mobility, self-care, and communication from admission to discharge. Comparative performance benchmarking is accomplished to see the relative efficiency of each province in converting budgetary input into potential rehabilitation throughput and functional improvement, and to get the best resourcing practices. Fig. 1 demonstrates the structure of the proposed study of this paper.

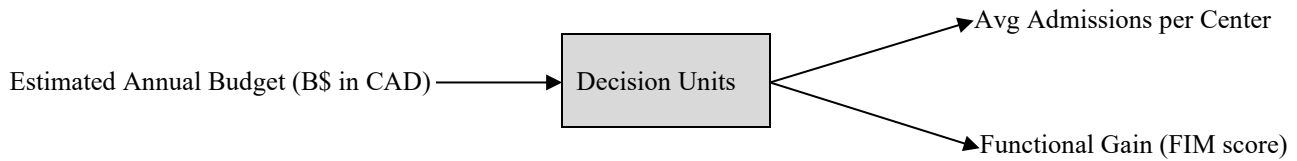


Fig. 1 The input/output factors used for the proposed study

The TOPSIS method is used for efficiency measurement of rehabilitation centers in 10 Canadian provinces. When measuring inputs, the TOPSIS model considers different cost/benefits depicted in Fig. 1. We therefore apply TOPSIS to find those provinces that perform relatively better in terms of using lower budget and producing higher throughputs. One important point for the implementation of the TOPSIS method is to consider appropriate weights for each of these three factors. In our study, we have considered four different scenarios by considering various weights for the factors. Here W_1 , W_2 and W_3 represent weight factors for Estimated Annual Budget, Avg Admissions per Center and Functional Gain (FIM score), respectively.

4. The results

In this section, we present the summary of the implementation of the TOPSIS method for computing the relative efficiency of ten provinces.

Table 2

The results of the implementation of TOPSIS methods for measuring the relative efficiencies of 10 province

Province	$W_1 = W_2 = W_3 = 1/3$	$W_1 = 0.5, W_2 = 0.25, W_3 = 0.25$	$W_1 = 0.25, W_2 = 0.375, W_3 = 0.375$
Ontario	0.2267	0.1279	0.3055
Quebec	0.6298	0.6374	0.6288
British Columbia	0.5142	0.5005	0.5331
Alberta	0.5794	0.5642	0.6005
Manitoba	0.8202	0.8626	0.7752
Saskatchewan	0.7941	0.8690	0.7273
Nova Scotia	0.8155	0.8868	0.7523
New Brunswick	0.7990	0.8831	0.7284
Newfoundland & Labrador	0.7799	0.8735	0.7037
Prince Edward Island	0.7785	0.8754	0.7009

Table 2 demonstrates the results of the implementation of the TOPSIS method for measuring the relative efficiencies of 10 provinces for the model shown in Fig. 1. According to our results, when we consider equal weights for three factors, Manitoba is ranked first followed by Nova Scotia, New Brunswick and Saskatchewan. When we increase the weight of the budget in our method, these provinces still perform better than other provinces. Even when we reduce the weights of the budget, these provinces demonstrate good performance. Surprisingly, Ontario has presented the worst performance compared with other provinces.

5. Discussion and Conclusion

The implementation of the TOPSIS method for assessing the Canadian provinces results in a distinguished and uniform sequence of rehabilitation efficiency. One of the most remarkable observations is the quite high ranking of Manitoba, Nova Scotia, New Brunswick, and Saskatchewan among the other provinces. In the case of the scenario where equal weights are assigned to all three factors, these provinces are placed at the top level with Manitoba at the forefront. Importantly, this situation of being at the top continues through different weightings. In case the Estimated Annual Budget importance is made larger or smaller these provinces do not only survive but they keep as well their usual performance. This suggests that their high positioning is not an artifact of one priority predetermined but rather it is due to a performance that is inherently strong and well-balanced across all metrics: they effectively make use of a lower budget while successfully generating higher admissions per center and getting superior patient functional gains (FIM scores).

The most unexpected and impressive finding is the continual low score of Ontario, which comes in last out of the ten provinces. Being the most populated and richest province in Canada, one would naturally expect it to be a forerunner in the efficiency of healthcare, however, this result points to a major problem in the system indicating that Ontario's rehabilitation sector is not able to convert its immense resources, (quite possibly the highest "Estimated Annual Budget") into justly high patient throughput and quality outputs. This is in line with health efficiency literature where larger, more complex systems

often experience diseconomies of scale, administrative overhead, or care coordination problems that dilute efficiency (Dearden et al., 2017). The Ontario case serves as a significant learning opportunity showing that higher budgets are not the same as better performance and that there is room for considerable efficiency improvement. When one looks at existing literature along with the mentioned findings one gets a more profound understanding. The uninterrupted triumph of smaller provinces such as Manitoba and Nova Scotia corresponds to the conclusions drawn by other health system studies. For example, Hollingsworth (2008) states that smaller, more integrated health networks can frequently outperform larger ones due to the fact that they can provide more streamlined operations and clearer accountability. The adoption of the FIM score as the main output, besides being a very good move, is in line with the current trend in value-based healthcare that mainly focuses on the more patient-centered outcomes and less on the volume metrics (Kohl et al, 2019). The performance of the leading provinces indicates that they are implementing this value-based principle in a very successful way.

Additionally, the combination of TOPSIS and sensitivity analysis (varied weights) confirms its usefulness. It goes from a mere ranking to showing the reliability of the results. The situation of the best and worst performers that stay almost the same no matter how the weights are assigned adds to the argument that the detected efficiencies and inefficiencies are inherent and not influenced by slight changes in policy priorities. To sum up, the present analysis very well points out Manitoba and its partners as the best practices in rehabilitation efficiency. On the other hand, it makes an urgent issue for Ontario to perform a complete internal review, perhaps comparing itself with the leading provinces to figure out how to improve its use of resources for better patient access and outcomes.

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