

# The use of an analytic hierarchy process to promote equity, diversity and inclusion

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## SUMMARY

Equity, diversity and inclusion (EDI) are increasingly important directives in medicine that add further complexity to adjudications. The analytic hierarchy process is proposed as a tool for multicriteria decision-making that can facilitate the incorporation of EDI directives, especially for collective, group determinations.

**T**he incorporation of equity, diversity and inclusion (EDI) in medicine is a moral imperative that can also improve patient care and the health care system. Although EDI directives are increasingly recognized in medicine, they increase the complexity of decision-making.

Several multicriteria decision-making methods are available, but the most straightforward and widely used technique is the mathematically based analytic hierarchy process. The analytic hierarchy process has been widely applied in medicine, science and business<sup>1</sup> and was recently proposed to promote EDI in economic decisions.<sup>2</sup> This process allows more rational decision-making when there are multiple, competing options, regardless of whether the decision criteria are qualitative or quantitative. The analytic hierarchy process uses pairwise comparisons of the designated criteria and eigenvector linear algebra to develop priority weightings for each criterion. For the process to yield correct results, the appropriate decision-making criteria must be identified, and their relative importance properly specified with the pairwise comparisons.<sup>3</sup> The pairwise comparisons are ranked using a fundamental scale of relative importance from 1 to 9, where 1 is designated “equal importance,” 3 is “moderate importance,” 5 is “strong importance,” 7 is “very strong importance” and 9 represents “extreme importance.”<sup>1</sup> An indication of the quality of the pairwise comparisons can be inferred from the consistency ratio, which should be less than 10%. An online calculator for the analytic hierarchy process is available.<sup>4</sup>

The analytic hierarchy process framework can incorporate EDI criteria into decisions regarding the recruitment, training, specialty selection, placement and retention with respect to underrepresented minorities, and help allocate medical care, research directives and medical resources to marginalized groups.<sup>5</sup>

The advantages of the analytic hierarchy process include intentionality for EDI, engagement from multiple stakeholders in group decision-making processes, enhancement of trust and the promotion of department morale in the attainment of diversity and inclusion excellence. The transparent use of an analytic hierarchy process may also help quell any concerns regarding reverse discrimination.

To illustrate the analytic hierarchy process, a framework for resident selection using the 8 Canadian Resident Matching Service (CaRMS) referee criteria,<sup>6</sup> is presented, adding EDI as a criterion. If the 9 selection criteria are

A – wrt AHP priorities – or B?		Equal	How much more?
1	<input checked="" type="radio"/> Cognitive skills & knowledge	<input type="radio"/> Problem solving & patient management	⊙1 02 03 04 05 06 07 08 09
2	<input checked="" type="radio"/> Cognitive skills & knowledge	<input type="radio"/> Behaviour & attitudinal skills	⊙1 02 03 04 05 06 07 08 09
3	<input type="radio"/> Cognitive skills & knowledge	<input checked="" type="radio"/> Communication skills & working relationships	⊙1 02 03 04 05 06 07 08 09
4	<input checked="" type="radio"/> Cognitive skills & knowledge	<input type="radio"/> Motivation & punctuality	⊙1 02 03 04 05 06 07 08 09
5	<input checked="" type="radio"/> Cognitive skills & knowledge	<input type="radio"/> Sense of responsibility	⊙1 02 03 04 05 06 07 08 09
6	<input checked="" type="radio"/> Cognitive skills & knowledge	<input type="radio"/> Procedural skills specific to discipline	⊙1 02 03 04 05 06 07 08 09
7	<input checked="" type="radio"/> Cognitive skills & knowledge	<input type="radio"/> Special qualities & unique contributions	⊙1 02 03 04 05 06 07 08 09
8	<input checked="" type="radio"/> Cognitive skills & knowledge	<input type="radio"/> Equity, diversity, inclusion	⊙1 02 03 04 05 06 07 08 09
9	<input checked="" type="radio"/> Problem solving & patient management	<input type="radio"/> Behaviour & attitudinal skills	⊙1 02 03 04 05 06 07 08 09
10	<input type="radio"/> Problem solving & patient management	<input checked="" type="radio"/> Communication skills & working relationships	⊙1 02 03 04 ⊙5 06 07 08 09
11	<input checked="" type="radio"/> Problem solving & patient management	<input type="radio"/> Motivation & punctuality	⊙1 02 03 04 05 06 07 08 09
12	<input checked="" type="radio"/> Problem solving & patient management	<input type="radio"/> Sense of responsibility	⊙1 02 03 04 05 06 07 08 09
13	<input checked="" type="radio"/> Problem solving & patient management	<input type="radio"/> Procedural skills specific to discipline	⊙1 02 03 04 05 06 07 08 09
14	<input checked="" type="radio"/> Problem solving & patient management	<input type="radio"/> Special qualities & unique contributions	⊙1 ⊙2 03 04 05 06 07 08 09
15	<input checked="" type="radio"/> Problem solving & patient management	<input type="radio"/> Equity, diversity, inclusion	⊙1 ⊙2 03 04 05 06 07 08 09
16	<input type="radio"/> Behaviour & attitudinal skills	<input checked="" type="radio"/> Communication skills & working relationships	⊙1 02 03 04 ⊙5 06 07 08 09
17	<input checked="" type="radio"/> Behaviour & attitudinal skills	<input type="radio"/> Motivation & punctuality	⊙1 02 03 04 05 06 07 08 09
18	<input checked="" type="radio"/> Behaviour & attitudinal skills	<input type="radio"/> Sense of responsibility	⊙1 02 03 04 05 06 07 08 09
19	<input checked="" type="radio"/> Behaviour & attitudinal skills	<input type="radio"/> Procedural skills specific to discipline	⊙1 02 03 04 05 06 07 08 09
20	<input checked="" type="radio"/> Behaviour & attitudinal skills	<input type="radio"/> Special qualities & unique contributions	⊙1 ⊙2 03 04 05 06 07 08 09
21	<input checked="" type="radio"/> Behaviour & attitudinal skills	<input type="radio"/> Equity, diversity, inclusion	⊙1 ⊙2 03 04 05 06 07 08 09
22	<input type="radio"/> Communication skills & working relationships	<input checked="" type="radio"/> Motivation & punctuality	⊙1 02 03 04 05 06 07 08 09
23	<input checked="" type="radio"/> Communication skills & working relationships	<input type="radio"/> Sense of responsibility	⊙1 02 03 04 05 06 07 08 09
24	<input checked="" type="radio"/> Communication skills & working relationships	<input type="radio"/> Procedural skills specific to discipline	⊙1 02 03 04 05 06 07 08 09
25	<input checked="" type="radio"/> Communication skills & working relationships	<input type="radio"/> Special qualities & unique contributions	⊙1 02 03 04 05 06 07 08 09
26	<input checked="" type="radio"/> Communication skills & working relationships	<input type="radio"/> Equity, diversity, inclusion	⊙1 02 03 04 05 06 07 08 09
27	<input checked="" type="radio"/> Motivation & punctuality	<input type="radio"/> Sense of responsibility	⊙1 02 03 04 05 06 07 08 09
28	<input checked="" type="radio"/> Motivation & punctuality	<input type="radio"/> Procedural skills specific to discipline	⊙1 02 03 04 05 06 07 08 09
29	<input type="radio"/> Motivation & punctuality	<input checked="" type="radio"/> Special qualities & unique contributions	⊙1 ⊙2 03 04 05 06 07 08 09
30	<input checked="" type="radio"/> Motivation & punctuality	<input type="radio"/> Equity, diversity, inclusion	⊙1 ⊙2 03 04 05 06 07 08 09
31	<input checked="" type="radio"/> Sense of responsibility	<input type="radio"/> Procedural skills specific to discipline	⊙1 02 03 04 05 06 07 08 09
32	<input checked="" type="radio"/> Sense of responsibility	<input type="radio"/> Special qualities & unique contributions	⊙1 ⊙2 03 04 05 06 07 08 09
33	<input checked="" type="radio"/> Sense of responsibility	<input type="radio"/> Equity, diversity, inclusion	⊙1 ⊙2 03 04 05 06 07 08 09
34	<input checked="" type="radio"/> Procedural skills specific to discipline	<input type="radio"/> Special qualities & unique contributions	⊙1 ⊙2 03 04 05 06 07 08 09
35	<input type="radio"/> Procedural skills specific to discipline	<input checked="" type="radio"/> Equity, diversity, inclusion	⊙1 ⊙2 03 04 05 06 07 08 09
36	<input checked="" type="radio"/> Special qualities & unique contributions	<input type="radio"/> Equity, diversity, inclusion	⊙1 02 03 04 05 06 07 08 09

CR = 3.2% OK  
 AHP scale: 1 - Equal importance, 3 - Moderate importance, 5 - Strong importance, 7 - Very strong importance, 9 - Extreme importance

**Fig. 1.** Hypothetical analytic hierarchy process (AHP) for resident selection, incorporating equity, diversity and inclusion with the referee criteria of the Canadian Resident Matching Service. Note: CR = consistency ratio; wrt AHP = numerical weight of the selection criterion.

rated of equal importance, EDI considerations will receive a maximum score of 11.1%. If, hypothetically, a large residency program decides that working relationships between the residents and staff are of strong overriding importance (level 5 on the analytic hierarchy process scale) compared with the other criteria, but that EDI and

“special qualities and unique contributions” are both slightly less important than the other criteria, then EDI receives a maximum weighting of 4.7% (Figure 1 and Figure 2). Each residency selection committee should perform its own pairwise comparisons to derive criterion weightings applicable to their program.

<b>Priorities</b>					
These are the resulting weights for the criteria based on your pairwise comparisons:					
Category	Priority	Rank	(+)	(-)	
1 Cognitive skills & knowledge	9.0%	4	1.6%	1.6%	
2 Problem solving & patient management	9.0%	4	1.6%	1.6%	
3 Behaviour & attitudinal skills	9.0%	4	1.6%	1.6%	
4 Communication skills & working relationships	31.1%	1	13.3%	13.3%	
5 Motivation & punctuality	11.7%	2	6.9%	6.9%	
6 Sense of responsibility	11.7%	2	6.9%	6.9%	
7 Procedural skills specific to discipline	9.0%	4	1.6%	1.6%	
8 Special qualities & unique contributions	4.7%	8	0.5%	0.5%	
9 Equity, diversity, inclusion	4.7%	8	0.5%	0.5%	

Consistency ratio CR = 3.2%

**Fig. 2.** Output of a hypothetical analytic hierarchy process for resident selection that incorporated equity, diversity and inclusion with the referee criteria of the Canadian Resident Matching Service.

## CONCLUSION

An analytic hierarchy process framework can assist in multicriteria decision-making to promote EDI directives. The analytic hierarchy process allows transparent group decision-making, and may promote selection committee morale by providing intentionality of EDI directives.

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**Competing interests:** None declared.

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## References

1. Saaty R. The analytic hierarchy process — what it is and how it is used. *Math Model* 1987;9:161-76.
2. Wong G. Your diversity, equity and inclusion initiatives are missing the point. Here's how to fix them. World Economic Forum; 2021. Available: <https://www.weforum.org/agenda/2021/03/how-to-improve-diversity-equity-inclusion-initiatives-business/> (accessed 2021 June 10).
3. Whitaker R. Criticisms of the analytic hierarchy process: why they often make no sense. *Math Comput Model* 2007;46:948-61.
4. Goepel K. Implementation of an online software tool for the analytic hierarchy process (AHP-OS). *International journal of the analytic hierarchy process* 2018;10:469-87.
5. Equity and diversity in medicine. Background to CMA Policy. Ottawa: Canadian Medical Association; 2020. Available: <https://www.cma.ca/physician-wellness-hub/topics/equity-and-diversity-in-medicine> (accessed 2021 June 10).
6. Canadian Resident Matching Service. Ottawa: CaRMS; 2021. Available: <https://www.carms.ca/match/psm/referees/reference-guidelines-psm-referees/> (accessed 2021 Jul.17).