THE PAST AND FUTURE OF THE AHP IN HEALTH CARE DECISION MAKING

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ABSTRACT

Objective. Health care decision making is a complex process involving many stakeholders and allowing for multiple decision criteria. The Analytic Hierarchy process (AHP) can support these complex decisions that relate to the application and coverage of health care technologies. The objective of this study is to review the past applications of the AHP in supporting health care decision making, and to make recommendations for its future use.
Method. We conducted a systematic review of AHP applications in health care, as described in the relevant medical, health-economical, psycho-sociological, managerial, and applied mathematical literature.
Results. We found 62 distinctive AHP applications in health care. Of the retrieved applications, 13 % focus on shared decision-making between patient and clinician, 27 % on the development of clinical practice guidelines, 5 % on the development of medical devices and pharmaceuticals, 40 % on management decisions in health care organizations, and 15 % on the development of national health care policy.
Conclusions. From the review it is concluded that the AHP is suitable to apply in case of complex health care decision problems, a need to improve decision making in stead of explain decision outcomes, a need to share information among experts or between clinicians and patients, and in case of a limited availability of informed respondents. We foresee the increased use of the AHP in health economical assessment of technology.

Keywords: Analytic Hierarchy Process, systematic literature review, health care decision making, health technology assessment.

1. Introduction

Patients and society poses high and diverse demands on health care interventions. The demands relate to medical and economical, social, legal, ethical, organizational or technical criteria. Established methods used in Health Technology Assessment or HTA can be roughly divided into clinical trials and economic studies. Clinical trials investigate the clinical outcome of health care interventions and build the evidence based medicine library. Clinical outcomes include for example mortality and morbidity. Economic

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evaluations, such as cost-effectiveness or cost-utility analyses, incorporate a broader range of outcome measures, such as quality-adjusted life years and willingness to pay, relative to the additional resources required for that particular intervention. All methods have in common that they are used to inform healthcare decision makers about the coverage and application of health care interventions. The process of health care decision making is, however, not only dependent on clinical and economic performance. It is a complex and multi-factorial process involving many stakeholders and allowing for different opinions.

Multi-criteria decision analysis (MCDA) can be used to support these complex and multifaceted decisions. They help decision-makers to evaluate a finite number of alternative health care interventions under a finite number of performance criteria. One validated technique for MCDA is Saaty's Analytic Hierarchy Process (AHP) (Saaty, 1994). Other commonly used tools for multi-criteria or multi-attribute decision analysis in health care are the elimination and choice translating reality (ELECTRE), the simple multi-attribute rating technique (SMART), multi-attribute utility theory (MAUT), and conjoint analysis. Experimental comparisons have been made and concluded that each of the MCDA methods has its own advantages and disadvantages. For example, in two studies comparing AHP and conjoint analysis it was concluded that AHP has clear advantages in case of complex decisions (Mulye, et al, 1998; Scholl, et al, 2005). Although much of the work on AHP has been done outside the healthcare sector, some empirical applications suggest that the AHP can be an effective tool to support health care decision making about the coverage and application of health care interventions (Dolan & Bordley, 1993; Hummel, et al., 1995).

2. Objective

The objective of this study is to review the past use of the AHP in health care decision making. Based on the review we aim to provide suggestions on the future use of the AHP in health care decision making and on its use for health economic evaluation of new technology in particular.

3. Methods

We conducted a systematic literature review on the use of the Analytic Hierarchy Process (AHP) in health care. Within de English language databases of Pub Med and Web of Science we searched in the abstracts for the keywords "Analytic Hierarchy Process" AND ("patient" OR "patients" OR "health" OR "healthcare" OR "medical" OR "clinical" OR "hospital"). All retrieved abstracts were screened to include only those articles that were actually focusing on the AHP methodology and on applications within health care. We then summarized the evidence on best practices regarding the decision tasks, patient-relevant criteria to include in these tasks, and characteristics of the AHP participants.

4. Results

We found 93 articles focusing on the use of the AHP in health care. In order to arrange the 62 distinctive AHP applications found, we distinguished among five decision task levels. Of the retrieved applications, 13 % focus on shared decision-making between patient and clinician, 27 % on the development of clinical guidelines, 5 % on the development of health care innovations, 40 % on management decisions in health care organizations, and 15 % on the development of national health care policy. Table 1, 2, 3, 4 and 5 describe the AHP applications in these decision areas.

Table 1. Shared decision making

Author	Year	# crit.	# alt.	Individual or group	Participants	Pairwise comparisons or direct rating
Shared decision making:						
Dolan	2002	7	6	individual	46 patients	pairwise comparisons
Liberatore	2003	12	3	group individual	focus group 60 patients	pairwise comparisons pairwise comparisons
Richman	2005	9	8	individual	12 clinicians	pairwise comparisons
Hummel	2005	5	2	individual	34 patients	pairwise comparisons
Katsumura	2008	13	2	individual	353 patients	pairwise comparisons
Van Til	2008	4	2	individual	17 patients	pairwise comparisons
IJzerman	2009	6	5	individual	142 patients	pairwise comparisons
Kitamura	2010	5	2	individual	31 patients	pairwise comparisons

In case of shared decision making, this review shows that individual patients can be supported to weight the diverse subjective and objective decision criteria. Most commonly, the amount of criteria range from 5 to 10 decision criteria. The outcomes only represent the preferred choice for the specific patient involved.

Table 2. Development of clinical guidelines

Author	Year	# crit.	# alt.	Individual or group	Participants	Pairwise comparisons or direct rating
Diagnosis:						
Cook	1990	9	12	group	clinicians	direct rating
Dolan	1993	5	4	individual	25 patients, 22 clinicians	pairwise comparisons
Castro	1996	4	4	individual	6 clinicians	pairwise comparisons
Saaty	1998	11	2	individual	clinician	pairwise comparisons
Koch	1998 - 2000	33	-	4 groups	health prof., relatives patients, citizens	direct rating
Barosi	2007		-	Individual and group	-	pairwise comparisons pairwise comparisons
Uzoka	2011	22	5	individual	6 clinicians	direct rating
Pecchia	epub	35	-	individual	191 health prof.	pairwise comparisons
Treatment:						
Peralta Carcelen	1997	5	2	individual	92 patients, 80 health prof.	pairwise comparisons pairwise comparisons
Dolan	1998	9	7	individual	61 clinicians	pairwise comparisons
Carter	1999	14	5	individual	2 clinicians	pairwise comparisons
Kuntz	1999	798	2	Individual and group	9 clinicians	pairwise comparisons
Hummel	2005	24	2	group	7 health prof., patient	pairwise comparisons
Singh	2006	10	4	-	-	direct rating
Van Til	2008	17	6	group	10 health prof.	pairwise comparisons
Sharma	2011	13	2	individual	96 patients	pairwise comparisons
Clinical performance measurement:						
Kunene	2005	9	-	-	-	direct rating

In case of clinical guidelines, individual clinicians and, if relevant, patients individually compare the relative importance's of the decision criteria. In case of new technology, the importance of the criteria can be assessed in a multidisciplinary group session. The criteria analysed commonly range from 10 to 15 decision criteria.

Table 3. Biomedical innovation

Author	Year	# crit.	# alt.	Individual or group	Participants	Pairwise comparisons or direct rating
Technology development:						
Hummel	2000	19	3	group	9 health prof., engineers	pairwise comparisons
Hummel	2000	24	3	group	8 health prof., engineers, patient	pairwise comparisons
Van der Wetering	2008	14	5	individual	6 health prof., engineers, patient, policy makers	pairwise comparisons

In case of early technology assessment, 15 to 25 decision criteria are assessed in a multidisciplinary group composed of clinicians, biomedical engineers and if relevant patients. The outcomes are meant to represent a specific group of patients.

Table 4. Health care management

Author	Year	# crit.	# alt.	Individual or group	Participants	Pairwise comparisons or direct rating
Equipment procurement:						
Sloane	2003 2004	23	3	individual	1 manager, 1 clin. engineer	pairwise comparisons
Balestra	2007	32	-	individual	2 clinicians	pairwise comparisons
Wu	2007	24	3	individual	13 administrators, researchers	pairwise comparisons
Baykasoglu	2009	10	2	group	10 managers, clinicians	pairwise comparisons
Contractor selection:						
Turri	1988	7	3	group	hospital committee	pairwise comparisons
Hsu	2008	22	4	Individual	6 hospital administrators	pairwise comparisons
Performance measurement of services:						
Bilsel	1996	24	9	individual	clients	pairwise comparisons
Longo	2002	11	8	Individual	nurses, clinicians and researchers	pairwise comparisons
Hariharan	2005	22	3	individual	clinicians, managers	direct rating
Dey	2006	25	3	6 groups	clinicians, managers	pairwise comparisons
Chang	2006	40	-	individual	30 clients	pairwise comparisons
Hsu	2009	17	-	individual	303 patients	pairwise comparisons
Ajami	epub	44	3	individual	researchers	pairwise comparisons
Appropriation of support services:						
Lee	1999	6	9	individual	system experts	direct rating
Rossetti	2001	18	2	individual	director	direct rating
Da Rocha	2005	4	2	-	-	direct rating
Strategic marketing:						
Javalgi	1991	9	3	group	managers, clinicians, patients	pairwise comparisons

Sinuany-Stern	1995	5	6	individual	11 experts	direct rating
Wu	2005	24	3	individual	13 administrators	pairwise comparisons
Tzung	2007	23	3	individual	207 patients	pairwise comparisons
Ohta	2007	5	9	-	-	direct rating
Human resource planning:						
Tavana	1996	13	7	individual and group	12 decision makers	pairwise comparisons
Kwak	1997	59	-	individual	policy experts	pairwise comparisons
Weingarten	1997	3	-	individual and group	hospital staff	pairwise comparisons
Liao	2009	12		individual	48 hospital staff	Pairwise comparisons

In case of management decisions, 15 to 25 decision criteria are generally analyzed in a group of 15 or less experts, including health professionals, managers, patients or others.

Table 5. Governmental policy

Author	Year	# crit.	# alt.	Individual or group	Participants	Pairwise comparisons or direct rating
Resource allocation to healthcare programs:						
Matsuda	1998	6	-	-	53 citizens	pairwise comparisons
Grof	2007	5	6	-	-	-
Taneja	2007	-	-	-	-	-
Shin	2008	25	2	individual	88 experts	pairwise comparisons
Bi	epub	4	40	-	-	pairwise comparisons
Policy for new technology:						
Cho	2003	8	88	group	8 clinicians, 4 engineers	pairwise comparisons
Nuijten	2004	3	3	individual	few experts	pairwise comparisons
Smith	2010	8	35	individual	4 experts	pairwise comparisons
Societal norms:						
Koch	1998	19	3	group	researchers	pairwise comparisons

In case of health care policy making, 10 to 15 decision criteria are generally analyzed either by a relatively large group of individual experts, or in a group session with 10 or less experts. The outcomes are intended to represent the general population, or a target group within this population.

5. Conclusions and discussion about the past of the AHP

From the review it is concluded that the AHP is increasingly being used in health care and provides valuable support in complex healthcare decisions. Most of the applications deal with complex decision structures. The most complex decision structures were found at the level of management in health organizations, and biomedical innovation. The evaluation of the effects of a new health intervention on the health care organization is often represented in complex decision structures. Technologies can be evaluated based on the costs, advantages and disadvantages for the groups involved. One appropriate application of the AHP involves group discussions between health professionals, managers, patients, or others. Likewise, the AHP can support the relatively complex decisions about technological innovations about which clinical evidence has not yet been gathered. In this case the technology can be assessed in a multidisciplinary group setting with technological developers with state-of-the-art knowledge about the new technology, and clinicians. For complex decisions about national health care policy, an alternative approach more often applied is to consult individual experts in a Delphi setting.

The AHP is also frequently applied to support clinical experts to decide upon clinical guidelines and to implement shared decision making. Shared decision making is the process of informing patients and eliciting preferences for treatment. If preferences among patients vary widely, or the preferences of the patients are likely to differ from the preferences of physicians, the AHP is valuable in this context.

6. Recommendations for the future of the AHP

In general, we recommend the use of the AHP to support the assessment of health care technology in case of complex decision problems, a need to improve decision making in stead of explaining decision outcomes, a need to share information among experts or between clinicians and patients, and in case of a limited availability of informed respondents.

We foresee the increased use of the AHP in conducting comprehensive Health Technology Assessments. The literature review has shown that the AHP is a valuable tool to support decision making about new health technology. The, consensus based, group decision making process allows a multi-disciplinary team of experts to judge the relative importance of the outcome measures of new technologies attributes and to reach a conclusion about the overall benefit of the technology being evaluated. In this respect, its main advantage is that it allows discussions between panel members and, hence, the exchange of information.

More specifically, AHP can be used to support health economic evaluations of new health care technology. Although AHP has primarily been developed to support management decision making, it may have a role in (1) prioritizing multiple patient-related outcomes in clinical trials and (2) analyzing the net benefit of health interventions. By developing a hierarchical structure of the outcome measures considered, it is possible to determine weights for separate and for categories of patient-relevant endpoints. This could be done before the benefits assessment, preferentially in a large group of informed patients. However, up to now AHP has not often been used for this particular purpose and more research is warranted on the applicability of AHP in a survey and the difference with utility based patient-reported outcome measures.

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