HEALTH TECHNOLOGY ASSESSMENT: NEEDS ANALYSIS VIA ANALYTIC HIERARCHY PROCESS

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ABSTRACT

The choice of a complex technology requires a detailed Health Technology Assessment (HTA). Before performing a HTA, it is fundamental to analyze scientifically all the clinical needs, which have to be satisfied. In this study we focused on the assessment of a CT scan, which is one of the most complex and costly biomedical device. A CT scan, is prevalently used in radiology, but its results are fundamental for the efficacy of different clinical intervention.

In this paper we present the results of a scientific needs analysis performed using AHP. We first defined a hierarchy of clinical needs, including 12 needs into four categories: performance, patients' safety, usability, technical Issues. Than we submitted questionnaires to clinicians with different specializations working in different units: radiology, emergency, minimally invasive ear surgery, neurology, emergency neurology. From the results it emerged that the priority of the needs differs for each specialization, and particularly if the device is used in an emergency unit or not. This strongly affects the choice of the model of CT scan into a process of HTA.

Keywords: HTA, AHP, CT scan.

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1. Introduction

The multi-slice CT scanner refers to a special CT system equipped with a multiple-row detector array to simultaneously collect data at different slice locations. The multi-slice CT scanner has the capability of rapidly scanning large longitudinal volume with high resolution.

There are two modes for a CT scan: step-and-shoot CT or helical (or spiral) CT. For step-and-shoot CT, it consists of two alternate stages: data acquisition and patient positioning.During the data acquisition stage, the patient remains stationary and the x-ray tube rotates about the patient to acquire a complete set of projections at a prescribed scanning location. During the patient positioning stage, no data are acquired and the patient is transported to the next prescribed scanning location. The data acquisition stage takes a time in the order a second (Ta) or less, the patient positioning stage takes a time in the order a second (Tp) too. Thus, the duty cycle of the step-and-shoot CT is [Ta/(Ta+Tp)]%. This poor scanning efficiency directly limits the volume coverage speed versus performance. Helical (or spiral) CT acquires continuously the data while the patient is simultaneously transported at a constant speed through the gantry. Therefore the duty cycle of the helical scan is improved to nearly 100%. This lead helical scanning to be currently the standard acquisition method for many CT acquisition (e.g thoracic) (Hui Hu 1999).

In recent years developments in CT technology have provided increasing temporal and better spatial resolution. Scan times are much shorter and slice thickness much thinner with increasing rotation speed and increasing number of active detector-rows, from 4 and 16 detector rows to 64-detector CT (MDCT) scanners (Kroft 2010).

Nonetheless, the most appropriate health technology is not necessary the most powerful or the last entered in the market. It is important to choose the best technology as the one how better fits the clinical needs without extraordinary performances not required, for which the stakeholder are not willing to pay. This becomes a must especially in countries in which the National Health Services are public.

In this study we performed a needs' analysis using AHP to understand how the performance of a CT scan is important in relation to other issues as patients' safety, usability, maintenance services. From our results it emerged that the priority of the needs differs for each specialization, and particularly if the device is used in an emergency unit or not. This strongly affects the choice of the model of CT scan into a process of HTA. Moreover, the performance of the CT scan, which strongly affects its costs, is not the most important need.

2. Methods

Trough focus group involving several experts, we defined a hierarchy of clinical needs, which have to be satisfied by a CT-scan. This hierarchy included the 12 needs grouped into four categories: performance, patients' safety, usability, Technical Issues. The hierarchy is presented in table 1.

Table 1. Hierarchy.

Need	**Dimension**
1. Spatial Resolution	Performance
2. Speed Run	
3. Processing software Tool	
4. Patient radiation dose	Patient Safety
5. Patient Monitoring	
6. contrast medium control	
7. Personnel Education	Usability
8. User-friendly GUI	
9. Interoperability with other HIS	
10. Technical Assistence	Technical Issues
11. Maintenance	
12. Data Storing	

Although we demonstrated in previous studies (Pecchia 2010) that electronic questionnaires reduce responders' errors, we submitted paper questionnaires to five clinicians with different specializations working in different units: radiology, emergency, minimally invasive ear surgery, neurology, emergency neurology. Figure 1 shows an exempla of the questionnaire submitted. We used Saaty fundamental scale for judgments quantification (Saaty, 1980).

Table 2. Questionnaires. Each responded was asked to cross only one word among those in italic: much less, less, equally, more, much more.

PERFORMANCE	is	*much less*	*less*	*equally*	*more*	*much more*	important hen	**SAFETY**
PERFORMANCE	is	*much less*	*less*	*equally*	*more*	*much more*	important hen	**USABILITY**
PERFORMANCE	is	*much less*	*less*	*equally*	*more*	*much more*	important hen	**MAINTENANCE**
SAFETY	is	*much less*	*less*	*equally*	*more*	*much more*	important hen	**USABILITY**
SAFETY	is	*much less*	*less*	*equally*	*more*	*much more*	important hen	**MAINTENANCE**
USABILITY	is	*much less*	*less*	*equally*	*more*	*much more*	important hen	**MAINTENANCE**

Since we were interested in exploring the difference in opinion among respondents weith different specialization, instead computing one average matrix for each category among all responded, for each respondent, we computed the local weight of each item within its dimension, the weight of each dimension. Finally, for each respondent we computed the global weight by multiplying the local weight of each need within its dimension for the weight of each dimension.

3. Results

Five clinicians with more than 20 years of experience, working in a public hospital of medium dimension, were involved in the study. Each one had experience of different clinical theaters, but each was asked to answer in relation to the experience in the actual unit: radiology, emergency, minimally invasive ear surgery, neurology, emergency neurology. All give coherent answers, achieving a consistent ration of less than .1 per each questionnaire. Also regarding categories' priorities, all the respondents gave coherent answers. The results are presented in Table 3 and Table 4.

Table 3. Categories' priority according to respondent answers.

	radiology unit	election ear surgery	neurology unit	emergency neurology unit	emergency unit
Performance	0.22	**0.44**	**0.39**	0.19	0.18
Safety	**0.48**	0.34	0.29	**0.57**	**0.60**
Usability	0.19	0.14	0.22	0.17	0.13
Technical Issues	0.11	0.08	0.10	0.08	0.09

Table 3. Needs priority according to respondent answers.

	radiology unit	election ear surgery	neurology unit	emergency neurology unit	emergency unit
Performance					
1. Spatial Resolution	0.32	**0.64**	**0.48**	**0.43**	0.30
2. Speed Run	**0.46**	0.11	0.11	**0.43**	**0.52**
3. Processing software	0.22	0.26	0.41	0.14	0.18
Safety					
4. Patient radiation dose	0.33	0.33	0.33	0.14	0.19
5. Patient Monitoring	0.33	0.33	0.33	**0.58**	**0.66**
6. Contrast medium control	0.33	0.33	0.33	0.28	0.16
Usability					
7. Personnel Education	**0.69**	**0.52**	0.32	**0.48**	0.33
8. User-friendly GUI	0.23	0.18	0.22	0.11	0.33
9. Interoperability	0.08	0.30	**0.46**	0.41	0.33
Technical Issues					
10. Technical Assistance	0.33	0.33	0.22	**0.66**	**0.46**
11. Maintenance	0.33	0.33	0.32	0.16	0.32
12. Data Storing	0.33	0.33	**0.46**	0.19	0.22

Finally, for each respondent we computed the global weight by multiplying the local weight of each need within its dimension for the weight of each dimension. The results are reported in Table 5.

Table 5. Global weight of each need

	radiology unit	election ear surgery	neurology unit	emergency neurology unit	emergency unit
Performance					
13. Spatial Resolution	**0,14**	**0,28**	**0,19**	0,08	0,05
14. Speed Run	**0,20**	0,05	0,04	0,08	0,09
15. Processing software	0,10	**0,11**	**0,16**	0,03	0,03
Safety					
16. Patient radiation dose	**0,16**	**0,11**	0,10	0,08	**0,11**
17. Patient Monitoring	**0,16**	**0,11**	0,10	**0,33**	**0,40**
18. Contrast medium control	**0,16**	**0,11**	0,10	**0,16**	0,09
Usability					
19. Personnel Education	**0,13**	0,07	0,07	0,08	0,04
20. User-friendly GUI	0,04	0,02	0,05	0,02	0,04
21. Interoperability	0,01	0,04	**0,10**	0,07	0,04
Technical Issues					
22. Technical Assistance	0,04	0,03	0,02	0,05	0,04
23. Maintenance	0,04	0,03	0,03	0,01	0,03
24. Data Storing	0,04	0,03	0,04	0,01	0,02

4. Discussion and conclusion

The results presented in Table 4, show that the relative importance of each category of needs, change according the intervention required. For instance, in election surgery and in neurology unit the performance was considered the most important cluster of need. Contrarily, in emergency the safety of the patient is considered crucial. All the clinicians considered quite important the patient safety. All the clinician considered as the less important the category of technical issues, but this is not a surprising result. Regarding the performance, in election spatial resolution Is considered the most important issue, while in emergency the speed of the duty cycle is the most important requirement. Also the radiologist judged the speed as the most important issue, but discussing with him this result, it emerged that he gave this answer thinking to the organization of the work in his unit. About safety, three clinicians on five considered all the issues equally important. Nonetheless, for emergency, the possibility of continuous monitoring the condition of the patients is the most important requirement.

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