Decision Analysis for a Data Collection System of Patient-controlled Analgesia With a Multi-attribute Utility Model

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Background: Data collection systems are very important for the practice of patient-controlled analgesia (PCA). This study aimed to evaluate 3 PCA data collection systems and selected the most favorable system with the aid of multi-attribute utility (MAU) theory.

Methods: We developed a questionnaire with 10 items to evaluate the PCA data collection system and 1 item for overall satisfaction based on MAU theory. Three systems were compared in the questionnaire, including a paper record, optic card reader and personal digital assistant (PDA). A pilot study demonstrated a good internal and test–retest reliability of the questionnaire. A weighted utility score combining the relative importance of individual items assigned by each participant and their responses to each question was calculated for each system. Sensitivity analyses with distinct weighting protocols were conducted to evaluate the stability of the final results.

Results: Thirty potential users of a PCA data collection system were recruited in the study. The item "easy to use" had the highest median rank and received the heaviest mean weight among all items. MAU analysis showed that the PDA system had a higher utility score than that in the other 2 systems. Sensitivity analyses revealed that both inverse and reciprocal weighting processes favored the PDA system. High correlations between overall satisfaction and MAU scores from miscellaneous weighting protocols suggested a good predictive validity of our MAU-based questionnaire.

Conclusion: The PDA system was selected as the most favorable PCA data collection system by the MAU analysis. The item "easy to use" was the most important attribute of the PCA data collection system. MAU theory can evaluate alternatives by taking into account individual preferences of stakeholders and aid in better decision-making. [*J Chin Med Assoc* 2010;73(10):533–539]

Key Words: decision analysis, multi-attribute utility, optic card reader, patient-controlled analgesia, personal digital assistant

Introduction

Patient-controlled analgesia (PCA) is a highly effective and widely accepted means of relieving post-operative pain.[1,2] The data collected from PCA practice are valuable to clinicians because useful information can be generated through judicious data analyses.[3,4] A reliable and thorough data collection system is important for management of PCA. An ideal data collection system has to possess favorable characteristics such as reliability, manageability, and low cost. Although it is difficult to find a perfect data collection system for PCA, selecting an optimal system from available options is necessary. To select the most suitable PCA data collection system for daily practice, objective evaluation of each candidate system before further decision-making is required. However, it is not easy to reach a consensus among potential users of such systems because individual preferences can be very different. Therefore, a more efficient and objective evaluation method is essential to select the most acceptable PCA data collection system.

To evaluate several alternatives, it is important to use a systematic approach to support decision-making processes. However, these processes can become fairly complicated if there are numerous factors to consider that are combined in different ways to produce various outcomes. For example, in choosing a PCA data collection system, alternative choices for various attributes should be compared. The relative contribution of each attribute to the overall decision should also be weighted. Multi-attribute utility (MAU) theory represents a group of methods to analyze situations and create evaluation processes.[5,6] It assesses individual preferences and constructs utility functions with mathematical methods to compare the weighted combination of attributes in evaluating alternatives. MAU theory has been effectively applied to some health-related behavior studies and medical decision-making, such as getting flu shots,[7,8] planning of emergency medical services,[9] purchase of ventilators,[10] and epidural labor analgesia.[11] In the current study, we used a MAU theory-based questionnaire to evaluate 3 PCA data collection systems: the personal digital assistant (PDA) system, the optic card reader (OCR) system and a traditional paper record. We then performed decision analysis on selecting an optimal PCA data collection system. To illustrate the process, a step-by-step procedure for creating a MAU-based decision analysis for selection of the PCA data collection system was provided. Sensitivity analysis was also conducted to evaluate the effects of distinct weighting processes on the overall scores.

Methods

Current situation analysis

This study was conducted in Taipei Veterans General Hospital, a tertiary medical center in Taiwan. There are approximately 5,000 PCA cases annually in our hospital. A PDA-based data collection system has been used for PCA practices since 2005 with the traditional paper recording system as a backup. Although the PDA system has operated well in the past, there have been increasing problems of malfunction in recent years. Thus, we conducted this study to determine which system should be developed and maintained in the future.

Participants

Participants were all potential users (named stakeholders in MAU analyses) of the PCA data collection system, including PCA team staff and residents in anesthesiology. The survey was conducted from January to April, 2009. All participants completed the questionnaire during this period.

Development of the MAU-based questionnaire

An expert committee was organized to develop a questionnaire based on MAU theory. The committee was composed of 4 members, including the leader of the PCA team and another 3 anesthesiologists. Following a literature review, open-ended discussions proceeded to formulate questions related to the PCA data collection system. All members were asked to discuss how to evaluate a PCA data collection system. New concepts about evaluation of the PCA data collection system proposed in each discussion were added to the preliminary questionnaire for the next discussion until no new issue was identified. After 3 conferences, we integrated 10 items to develop the main questionnaire for evaluation of the PCA data collection system.

The final version of the preliminary questionnaire was finished at the third meeting. Consensus on the content validity of the questionnaire was reached, and no redundancy or insufficiency of concepts was found. Appropriate wording, order, style, and semantics of the questionnaire were also verified. The final version yielded 10 items related to evaluation of the PCA collection system and 1 item for overall satisfaction with specific systems. A blank space was reserved at the beginning of each item for respondents to assign item weight to it. An additional item assessing overall satisfaction with a system was attached to the end of the questionnaire. Three systems were compared in the questionnaire, including the paper record, OCR and PDA. A pilot study was conducted to evaluate its reliability after construction of the questionnaire. The final version of questionnaire is presented in the Appendix.

Pilot study

Ten anesthetic residents and nurse anesthetist trainees were recruited in the pilot study. After explanation of the judgment task, participants were asked to respond to the 11 items in the questionnaire and assign item weight to the first 10. For each item, the participants judged each system on whether it conformed to the item statement or not and then answered to which extent they agreed using a Likert scale from l to 5. All participants in the pilot study were asked to repeat the questionnaire 1 week later to assess test–retest reliability. After completion of the pilot study, the collected data were submitted to reliability analysis. The Cronbach's α value of the first 10 items was 0.76, which indicated acceptable internal reliability.[12] The test–retest reliabilities for summated item score and item weight were 0.89 and 0.82, respectively. After confirmation of internal consistency and test–retest reliability of the questionnaire, the main study was conducted to evaluate the utility of the 3 PCA data collection systems.