



Assessment of surveys for the management of hospital clinical pharmacy services



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ABSTRACT

Objective: Survey data sets are important sources of data, and their successful exploitation is of key importance for informed policy decision-making. We present how a survey analysis approach initially developed for customer satisfaction research in marketing can be adapted for an introduction of clinical pharmacy services into a hospital.

Methods and material: We use a data mining analytical approach to extract relevant managerial consequences. We evaluate the importance of competences for users of a clinical pharmacy with the OrdEval algorithm and determine their nature according to the users' expectations. For this, we need substantially fewer questions than are required by the Kano approach.

Results: From 52 clinical pharmacy activities we were able to identify seven activities with a substantial negative impact (i.e., negative reinforcement) on the overall satisfaction of clinical pharmacy services, and two activities with a strong positive impact (upward reinforcement). Using analysis of individual feature values, we identified six performance, 10 excitement, and one basic clinical pharmacists' activity. **Conclusions:** We show how the OrdEval algorithm can exploit the information hidden in the ordering of class and attribute values, and their inherent correlation using a small sample of highly relevant respondents. The visualization of the outputs turns out highly useful in our clinical pharmacy research case study.

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1. Introduction

In spite of a plethora of new information sources available, surveys are still the most important and frequently used tool for managers and decision makers when investigating alternative outcomes and possible strategies before making important decisions. Any progress made in this standard tool which would allow better insight into the information gathered is therefore an important contribution, not only to the field of data analytics, but also to the applicative fields using the surveys.

Clinical pharmacy is a relatively new discipline in the pharmacy profession. It is patient—rather than drug-oriented, and aims to improve the quality of drug therapy. An acceptance of clinical pharmacists in hospital wards depends on how well their activities meet the needs and expectations of physicians and nurses.

Physicians' perceptions of the importance of clinical pharmacy activities differ substantially from pharmacists' perceptions [1]. Therefore, it is necessary to recognize the most important clinical pharmacy activities from the perspective of its users, namely physicians and nurses'.

According to the behavioural decision theory and total quality management approach of Kano [2,3], the analysis of customer needs is a three-phase process: (1) understanding customer preferences, (2) requirement prioritization, and (3) requirement classification. The Kano model is widely used in several industries as an effective tool to understand the first phase, namely customer preferences. Kano proposed a two-dimensional system for quality management (expectations vs. satisfaction), where he identified three levels of customer expectations. Satisfying basic expectations keeps customers satisfied, while not meeting their expectations makes them dissatisfied. These kinds of expectations are denoted dissatisfiers or basic, or must be expectations. The second type of expectations make customer satisfied/dissatisfied depending on the quality/quantity of performance that is why they are called 'performance expectations.' 'Customers' expectations of the third type

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are hidden, unconscious expectations. Satisfying those makes a customer delighted. These are delighters or excitement expectations.

In connection with his theory of two-dimensional quality—the customer satisfaction relationship, Kano proposed the structure of the survey questionnaire to categorize the quality attributes. For each product's feature a pair of questions must be formulated, to which the customer can answer in one of five different ways [3]. The first question is concerned with the reaction of the customer if the product has that feature (functional form of the question); and the second is concerned with his reaction if the product does not have that feature (dysfunctional form of the question). Using Kano's model, quality attributes that have the greatest influence on customer satisfaction can therefore be identified. On the other hand, the questionnaire, proposed by Kano, can be very long when many features are explored, which can result in a lower response rate.

As an alternative, we present a case study how a survey analysis approach called 'OrdEval,' initially developed for customer satisfaction research in marketing, can be adapted to a completely different problem, namely the introduction of clinical pharmacy services into a hospital. The approach is based on the evaluation of ordinal attributes, i.e. survey questions and their relation to the expected outcome. By taking the ordinal nature of many surveys' questions into account the approach allows a sort of what-if analysis. Conditional probabilities of the expected outcome are computed, where the condition is upon changes in outcomes of survey questions. An example of the output would be a probability of a more successful service introduction if certain features of the service are better communicated to the users. As human resources are limited, such knowledge is valuable for efficient allocation of the resources. The approach also allows categorization of the clinical pharmacy activities, according to the Kano model. The motivation and contribution of this paper is to: demonstrate how OrdEval works in a medical management context, how its output can be visualized and adapted to include information relevant for decision makers, and to provide new insights into clinical pharmacy services, which are used as our application topic.

As our study is interdisciplinary and composed from machine learning and clinical pharmacy, we would like to warn the readers about the terminology used, which might be typical for one area and unusual for the other. *Attribute* or *feature* is a property of an object or person. Research objects in our study are clinical pharmacy activities and pharmacists' competences. Clinical pharmacy *activities* are specific professional activities of pharmacists that comprise clinical pharmacy services in a health care setting. *Competences* are knowledge and skills of pharmacists, acquired through formal and informal study and training programmes.

The paper is divided into six sections. In Section 2, we discuss related work. In Section 3, we present a clinical pharmacy study, and the survey we designed to measure the expectations of doctors, nurses, and pharmacists. In Section 4, we describe the OrdEval approach to evaluate attributes and the way the attributes can be interpreted. In Section 5, we present the results of our analysis with an emphasis on the methodological contributions of OrdEval. In Section 6, we conclude with an overview of the contributions and plans for further work. Appendix A contains the survey questions used and some basic statistics of the collected data set.

2. Related work

The presented work is unique in its use of OrdEval method in medical HR management, but in a broader context it can be related to customer satisfaction analysis in marketing, introduction of clinical pharmacy to hospital, applications of Kano model, and factor analysis via feature evaluation in the context of machine

learning. We briefly review the relevant contributions from these areas starting with the motivation for our study.

As good interprofessional collaboration between pharmacists and physicians and between pharmacists and nurses can lead to substantial decrease of medication errors [4–10] our goal was to introduce clinical pharmacy service to a large hospital and improve the interprofessional collaboration. Different approaches have been studied to improve this collaboration, among which satisfaction is of particular interest [11–15].

A typical approach in practical marketing research of customer (dis)satisfaction is to define a number of features of the product/service and then to conduct a survey on a representative sample of customers where the customers rate their satisfaction with each of the features and also express their overall (dis)satisfaction. The goal of this feature analysis in marketing research is manifold: (1) identify features which influence the overall (dis)satisfaction most; (2) identify type of features (basic, performance, excitement), (3) identify those attribute values (thresholds) which have positive/negative impact on overall satisfaction; (4) identify typical behavior patterns of attribute values (upward reinforcement, downward reinforcement, anchoring, compensation). Initially, the effects of the attribute-level performance on consumer (dis)satisfaction were assumed linear and symmetric, see for example [16,17]. Some marketing scholars have questioned this assumption on the basis of economic and psychological theory as well as on a better empirical insight in the satisfaction response function [18]. Robnik-Šikonja and Vanhoof [19] offered as a solution to several of the above stated goals with OrdEval algorithm and showed its use on a business to business (B2B) and business to customer (B2C) customer satisfaction problem. Later the approach was successfully applied in country of origin analysis [20], hearing aid selection [21], and supplier selection in public sector [22]. In contrast to these applications of OrdEval in marketing context, our work introduces OrdEval to the HR management and to the medical domain, where the goals stated above are also highly relevant.

Introduction of clinical pharmacy services was evaluated in [1,14,23–34], but studies exploring the stakeholders' needs, expectations, and perceptions of clinical pharmacy services before their introduction are rare [35]. Only a few studies investigated the perception of clinical pharmacy services by all three professional groups involved—pharmacists, physicians and nurses [1,32,33]. Dussart et al. [32] investigated satisfaction with one particular pharmacist's service, i.e., individualized dispensing system. Gillespie et al. [14] conducted three different surveys, each designed for one profession. In our research the survey was conducted before the clinical pharmacy service was introduced, it includes the vast majority of all clinical pharmacy activities and the same questionnaire was used for all three professional groups.

Kano model is widely used in many different industries, like technical products, mass-market services, sports products, information systems, customer services [36], as well as in health care services [37–40], but it has not been used before for the evaluation of clinical pharmacy services.

Kano's unique approach in satisfaction measurement is his assumption that customers' satisfaction is not necessary proportional to how functional the product or service is. When applying Kano model, different instruments have been used to assess the quality of attributes [36]. According to the Kano methodology, a questionnaire consists of sets of functional/dysfunctional questions for each attribute, which requires the number of questions to be double the number of attributes. Other measurement tools include critical incident technique (CIT), regression analysis with dummy variables/penalty-reward contrast analysis, and importance-grid analysis. Different types of regression analyses are used to assess different Kano quality elements, but almost all authors use multiple

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