

**A FRAMEWORK FOR STUDY AND DESIGN OF
EMERGENCY MEDICAL SERVICES QUALITY**

Hariharan Seetharaman¹ and Diana Andreeva²

¹Anaesthesia & Intensive Care Unit, School of Medicine

University of the West Indies, Trinidad and Tobago, email: uwihari@yahoo.com

²Diagnostic Consulting Center 2, Drushba, Blok 112, 5800 Pleven, Bulgaria

email: didi.andreeva@abv.bg

Abstract

A framework for adaptive evaluation of the quality and design of emergency medical services is proposed. It is based on a modification of SERVQUAL checklist tool using a computational intelligence-based evaluation model. This framework enables the adaptive determination of the most important criteria and of the generation of recommendations for improving the emergency medical services quality. Data from medical staff and hospital patients are collected by the checklist tool. Then evaluations are calculated using applying the framework. Based on the framework the most important criteria that affect service quality in the emergency medical services are determined. Relevant recommendations and measures for improving the emergency medical services are proposed. It is expected that the framework will have significantly better performance than traditional methods. This framework is illustrated by a case study in three hospitals of Trinidad and Tobago. An initial study using this framework in a hospital has shown that after implementation the framework recommendations the emergency medical services quality index can rise by more than 50 percent. The advantages of framework compared to other approaches are discussed.

Key words: emergency medical services, quality, evaluation, design

1. INTRODUCTION

Today, service industries are preponderant and account for 60 or 70 percentage of the total worldwide GNP [27]. One of the fastest growing industries in the service sector is the health care industry. While all hospitals provide basically the same types of services, they do not provide the same quality of service [46]. Since 1980 the role of hospital service quality (HSQ) has been widely recognized as a critical determinant for the success and survival of a hospital in today's competitive environment. Any decline in patient satisfaction due to poor service quality would be a matter of concern [41].

In the health care industry, the raising technological developments as well as quality standards have had an important impact on medical care, surgical techniques, drugs, equipment, and the organization and delivery of health care [34]. Despite the improvements in the health care industry, it is still very difficult for the patients to evaluate the quality of service received either before or after its delivery. In choosing a hospital, patients usually seek information on indicators of medical competence and assurance. They especially seek evidences indicative of the hospital's quality such as certificates, quality awards, or other evidences of the physician's and staff's qualifications and the utilization of most recent medical developments and techniques.

Service quality in the health care can be defined in various ways depending on who the evaluators are; e.g. practitioners, patients. However, the patient's perspective is increasingly being viewed as the most

meaningful indicator of health care service quality. From this perspective the health care service quality is a result of the comparison that patients make between their expectations about a service and their perception of the way the service has been performed. Hence service quality is often conceptualized as the comparison of service expectations with actual performance perceptions [15][16][33][42][43][47]. The research on service quality is dominated by the SERVQUAL checklist tool, which is based on the so-called “gap” model [5].

There are numerous studies measuring service quality in the health care industry using SERVQUAL. Usually in these studies different types of mathematical and statistical methods are used such as exploratory factor analysis [11][12][19][52], confirmatory factor analysis [17][50], structural equation modeling [466][22][36], regression analysis [23][45][32], discriminant analysis [40], conjoint analysis [20], and gap analysis [26][53].

The increases in computer power, in the one hand, and the decrease in computer costs, on the other hand have stimulated the research on computational intelligence like Artificial Neural Network (ANN). Recently many ANN models have been applied in service industry [18][21] [30]. Many ANN applications in health care industry use ANN models as an alternative to multivariate statistical methods such as logistic regression analysis. They attempt to show that ANN models have better predictive power than multivariate statistical methods.

Goss and Vosikis [30] used ANN approach to measure the likelihood of intensive care unit recovery and compared it with logistic regression model. This study showed that ANN approach predicts mortality rate in intensive care units more correctly than the statistical technique. Goss and Ramchandani [29] evaluated the survival prediction accuracy in the intensive care units using ANN approach comparing it with binary logistic regression model. The study concluded that ANN outperforms binary logistic regression model. Morrison et al. [38] employed ANN technique to predict total health care costs of Medicaid recipients.

There are various studies in the health care, which employed ANN techniques with supervised learning to measure hospital performance or to predict health care costs in the hospital. However, we could not find any study that uses ANN methods to evaluate health care service quality by SERVQUAL-based patient’s survey. We found only a few studies using ANN methods and SERVQUAL questionnaire instrument in other service industries. For example, Tsaur et al. [51] employed backpropagation neural networks model for analyzing the guest loyalty toward international tourist hotels. They compared ANN approach with logistic regression model. The ANN model outperforms regression models in overall model fitting. Davies, Moutinho, and Curry [25] used backpropagation neural network model to measure ATM user attitudes. Behara, Fisher, and Lemmink [13] employed ANN technique to evaluate service quality of auto dealerships in the Netherlands using SERVQUAL based customer survey.

There are many methods for emergency medical services quality (EMSQ) assessment. Their drawback is that they do not provide recommendations for improving EMSQ. Here we propose a computational intelligence-based framework for adaptive quality evaluation of emergency medical services, which also generates improvement recommendations for emergency medical care services. The framework supports better understanding of patient’s perceptions of emergency medical service quality and its improvement.

2. FRAMEWORK DESCRIPTION

The objective of the framework is to improve the quality of emergency medical services applying computational intelligence-based evaluation and design using the framework.

The emergency medical care providers need a better understanding of the key dimensions constituting emergency medical care quality and valid approaches to their measurement. There is considerable discrepancy regarding emergency medical service quality: what to measure and how to measure. In this study, to alleviate some of these difficulties, a framework for adaptive framework quality evaluation of emergency medical services quality is proposed. It is based on a SERVQUAL checklist tool [1][2] using a computational intelligence-based evaluation model. Based on this framework are adaptive determined the most important criteria and recommendations for improving the emergency medical service quality.

The steps of the framework are shown on Fig.1. Principal purposes of this framework are: 1) aggregating the emergency medical service data for quantitative framework evaluations; 2) selection of important EMSQ evaluation criteria for the generation of framework recommendations and measures for emergency medical services quality improvements.

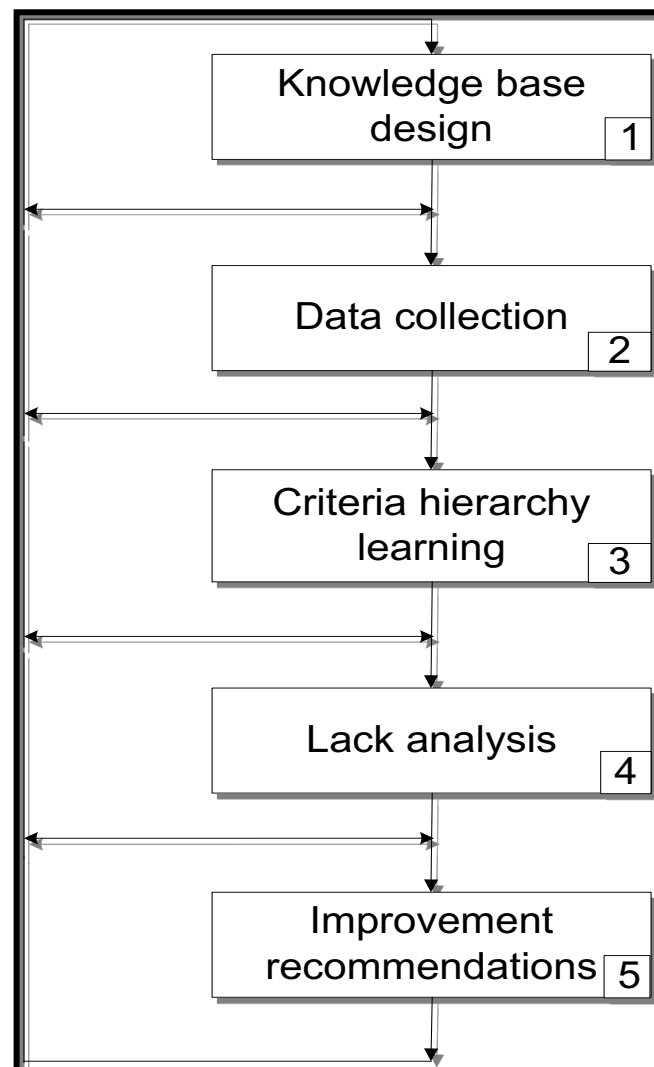


Fig. 1. Framework sequence of steps

The most important criteria for measuring emergency medical service quality and improvement and redesigning areas are determined. After implementation of such redesign recommendations, the emergency medical service quality index of the hospital is expected to increase by more than 50%.

3. CASE STUDY

This framework is illustrated by a case study with 540 patients in three public hospitals in Trinidad and Tobago. By a questionnaire survey are determined the current quality of services offered at the emergency medical services at the three public hospitals - Eric Williams Medical Sciences Complex, Port-of-Spain General Hospital and San Fernando General Hospital shown below.



The target population includes managers, clinicians, support staff and patients who were treated for at the A&E Departments at the three hospitals during the period of three months. The inclusion criteria are persons willing to participate in the questionnaire evaluation. The exclusion criteria are persons unwilling to participate

For data collection the framework questionnaire is administered to the target respondents in three hospitals after obtaining consent and responses are recorded as follows on Table 1.

Table 1. Sample size of data collection

Group	Number	Hospitals	Total number
Managers	10	3	30
Clinicians	20	3	60
Support staff	50	3	150
Patients	100	3	300
Total			540

In the *data collection step* particular attention was paid to the pre-testing of the questionnaire. Respecting the ethical considerations we obtained informed consent from the participants. No respondent identifiers are recorded. Data for this study are gathered using the framework questionnaire (cf. Appendix I) that is distributed to 540 persons in three hospitals. Each checklist item is rated on a seven-point Likert scale anchored at the verbal statement “Strongly Disagree” to which is associated a value of 1 and the verbal statement “Strongly Agree” valued at 7. The usable questionnaires returned are used for subsequent analysis. Data are coded and stored in a personal computer for 2 years with access only to the investigators. During dissemination of data no individual identifiers are recorded such as hospital name or the management team.

By the framework the most important criteria for measuring emergency medical service quality and improvement and redesigning areas are determined.

4. CONCLUSIONS

A framework for adaptive evaluation of the quality and design of emergency medical services is proposed. It is based on a modification of SERVQUAL checklist tool using a computational intelligence-based evaluation model. This framework enables the adaptive determination of the most important criteria and of the generation of recommendations for improving the emergency medical services quality. It is illustrated by a case study in three hospitals of Trinidad and Tobago. An initial study using this framework in a hospital has shown that after implementation the framework recommendations the hospital service quality index can rise by more than 50 percent.

The advantages and further developments of the framework are the following:

Advantages

- This framework enables the adaptive determination of the most important framework criteria and of the generation of recommendations for improving the emergency medical service quality.
- It is expected that the framework will have significantly better performance (much lower error rate) in comparison to other evaluation methods such as categorical regression and ordered regression. Framework computational intelligence modeled better non-linear dependencies characterizing the emergency medical service quality data.
- By the framework, not only the critical factor and related improvement areas regarding the emergency medical service quality in a hospital can be ascertained, but also the degree to which the service quality can be improved after taking corrective actions by hospital managers.
- Hospital managers can measure by the framework their hospitals’ service quality from the customer’s viewpoint.
- Using the lack analysis, hospital managers can formulate their management strategies to redesign and to improve their service delivery system.

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- The result of the evaluation can assist in the appropriate allocation of the annual budget and of other management resources.

Further Development

- The framework conceptual domain can be extended by measuring the relationship between service quality and patient satisfaction, loyalty and its influence on performance of the hospital.
- This study can be applied in profit-oriented hospitals and customer profile can be evaluated and compared with patients of non-profit hospitals.
- The evaluation of current service quality is carried out according to the service recipients' perception. It is very valuable to add physicians' perception of service quality when designing and improving the health care delivery system.
- The framework is not considering expectations of patients. It could be further developed to consider expectations of patients and measure how expectation effects overall service quality.

APPENDIX I

SERVQUAL Checklist 0[2]

Tangibility

1. Emergency Department (ED) has up to date equipment and technology.
2. Physical facilities in ED are visually appealing.
3. Bathrooms are very clean in ED.
4. Rooms of the hospital are very ED.
5. Hospital meals are attractive.
6. Hospital food has right temperature.
7. Nurses of the hospital respect to privacy.
8. Hospital rooms are quiet.
9. Parking in hospital is convenient.

Reliability

10. Food is delivered by a certain time in ED.
11. When hospital staff promises to do something by a certain time, they do it.
12. They keep patients' records accurately in hospital.
13. They tell their customer exactly when services will be performed.

Responsiveness

14. Patients who will be discharged have prompt service from employees of the ED for the discharging operations.
15. Patients are delivered prompt services from nurses when the patient needs to them.
16. Patients who come to ED get prompt service from employees of hospital for the admission operation.
17. Employees of ED are always willing to help their patients.
18. Employees of ED explain appropriately customer' question about discharging process.
19. Employees of ED explain customer' question appropriately about the any procedure.
20. Treatment is explained to the patient very clearly in ED.
21. Discharging process is explained to the patients' family.

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Assurance

- 22. Customers trust nurses of ED.
- 23. Patients can feel safe in their transactions with hospitals' employees.

Courtesy

- 24. Hospital employees are polite during admissions procedure.
- 25. Nurses are cheerful.
- 26. Hospital visitors are treated well.

Overall ED Quality

- 27. Overall quality of Emergency Medical Service.

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