

PROBLEMS OF USE IN THE VIEW OF INCREASING AUTOMATION IN OPERATING THEATRES FOR ENT FESS SURGERY

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Abstract: The study currently conducted at the International Reference and Development Centre for Surgical Technology (IRDC) in Leipzig focuses on the differences shown in usability evaluations of integrated vs. conventional operating theatres for ENT, particular FESS surgery.

Keywords: Usability, Software Ergonomics, Integrated OR, ENT, Image-Guided Navigation (IGN)

Introduction

During the last 5 years the requirements for operating theatres have increased significantly. Today one differentiates between integrated and conventional operating theatres. There is no precise definition of what constitutes an integrated operating theatre – a key characteristic is a major improvement of the functional, architectural and hardware-ergonomic integration of different medical and non-medical devices in an operating theatre.

One challenge for integrated OR software and information systems is to elaborate usability guidelines for increasingly complex steps in a process, which need to be standardised and efficiency improved despite the increased complexity of the operating theatre. [1].

This challenge also exists for specialised surgeries with minimally invasive access and endoscopic visualisation such as the ENT surgery. For this reason we endeavour to make use of previous results and improvement measures for laparoscopic scenarios recommended in conclusion in the specialist area of ENT, in particular the navigated ENT surgery.

Any function that is executed partially or completely by a computer, which has been previously performed only by a human, is defined as automation [2, 3].

Surgeons are supported by the image-guided navigation (IGN) through the correct spatial localization of the surgical instrument as well as the identification of relevant vital structures within the 3D space of the patient's anatomy.

These, for a surgeon demanding tasks concerning anatomical knowledge and cognitive skills are with the IGN partially automated functions, which delegated to a computer-based navigation system [4, 5].

The latest generations (e.g. 3rd generation at IRDC) of an integrated OR having available additional functions like Navigation Active Control (NAC), which prevents actively a collision for surgical instruments and a workflow-support for users. The picture below shows the principal of NAC;



Figure 1: Navigation Active Control

Method

The previous studies of usability issues for laparoscopic surgeries shows that two types of problems of use occur frequently during a surgery [6].

An investigation currently conducted at the International Reference and Development Centre for Surgical Technology (IRDC) in Leipzig focuses on the differences shown in usability evaluations of integrated (3rd generation) vs. conventional operating theatres for ENT surgery.

In a cross sectional study functional endoscopic sinus surgeries (FESS) are being investigated in respect of the occurring usability issues, the number of required process steps and a subjective usability evaluation of the human-computer-interaction.

The selected FESS surgeries (N=20) are conducted by teams comprising surgeon, nurse and anaesthesiologist,

who are, in respect of the parameters (i) experience in FESS surgery, (ii) handling of used technical equipment (iii) affinity towards technology and (iv) demographic characteristics as homogenous as possible. Also, the FESS surgeries are being equally distributed for the two groups integrated operating theatre (N=10) and conventional operating theatre (N=10).

Problems of use describe a mismatch between the user and the software, assuming the needed functionality is given. The human error taxonomy developed by Zapf et al. differentiates problems of use according to levels of action regulation and steps in the action process, distinguishing between functionality problems, usability problems, interaction problems and inefficient behaviour [7].

At this point we would like to pay a special attention to the expected occurrence of knowledge based errors and omission problems for higher integrated operating rooms applying (partially) automation as IGN, because such errors were most obvious in the investigation of laparoscopic standard procedures.

Results

In previous investigations of laparoscopic standard procedures the usability issues of omission problems (61% of 414) and knowledge-based errors (16% of 414) have been found frequently. Knowledge-based errors are defined as actions, which do not achieve the intended outcome due to knowledge deficits. Omission problems are defined as not executed well-known sub-plans by a user, e.g. due to interruption.

The high frequency of this type of problems of use can be explained by an insufficient workflow-support and poor control concept from a usability view in a consolidated system consisting of multiple medical devices of various manufacturers so far.

The following results are to be expected from our study of FESS surgery:

- (i) The additional active control function (NAC) in operating theatres of the 3rd generation lead, due to the additional information available to a reduction of knowledge based errors compared to a conventional operating theatre.
- (ii) The operating theatre of the 3rd generation reduces omission problems due to its standardised and implemented workflow-support of the users compared to a conventional operating theatre.
- (iii) The operating theatre of the 3rd generation should be evaluated as more ergonomic by the users (surgeon, nurse and anaesthesiologist) when completing the standardised questionnaire for the evaluation of the ergonomic quality of software products 9241/10-S [8, 9].

In this current research project we are also expecting to proof an increased user satisfaction, increased patient safety (e.g. structural risk) as well as a reduction of the number of individual computer-interaction-tasks and a shortening of surgery slot times.

Discussion

First of all, the international standard of usability DIN EN ISO 9241 [10], needs further elaboration to address complex integrated systems which experts, such as an OR team, use in collaboration.

In the second place due to the increasing integration of modern technology in the operating theatre both the manufacturers of medical devices and the medical personnel are subject to new challenges; not only medical devices need to be improved but also medical personnel, especially surgeons will need to be prepared to accept and actively support the transparency of surgical processes and methods caused by the increased standardization of procedures in the operating theatre.

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