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Original study

Medical utilization of Kiosk in the preoperative assessment of the ASA physical status: a pilot study

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Abstract

Background: **The use of healthcare kiosk is increasing in the medical community. However, there are scares data on its use in a pre-operative clinic.**
Objective: **The aim of this study is to validate an electronic questionnaire to assess the ASA physical status.**
Design: **monocenter retrospective pilot study**
Setting: **Tertiary hospital.**
Patients: **323 adults having a pre-operative visit prior to elective non-cardiac surgery.**
Main outcome measures: **A questionnaire including 20 items (yes/no) was designed and inserted in the Kiosk. The ASA score was then retrospectively estimated by an anaesthesiologist not involved in preoperative visit, considering the total number of positive answers of the questionnaire inserted in the Kiosk. The answers to the questionnaire from the Kiosk were blinded to the anaesthesiologist performing the pre-operative face-to-face assessment. Agreement between both ASA scores provided from both anaesthesiologists was analysed using Cohen's Kappa test (κ).**
Results: **Agreement between ASA score estimated by kiosk answers and ASA score from face-to-face examination was substantially good with K=0.628 (P<0.001).**
Conclusion: **Our electronic questionnaire is accurate in estimating patient's physical status. A kiosk can be used to detect low risk patients in order to facilitate the preoperative assessment. However, it cannot replace a complete evaluation by a physician.**

Key words: **Preoperative assessment, healthcare kiosk, electronic questionnaire, ASA physical status.**

Introduction

The pre-operative evaluation is the first step in ensuring the safe conduct of anaesthetic care in patients of all ages. It has been proven to improve outcome, to lower cancellations and delays, and to improve providers' and patients' satisfaction[1-3].

Over the time, this process of pre-operative evaluation has changed significantly[4,5].

As the transition from traditional paper records to electronic medical records has continued, healthcare providers have continuously looked for new and improved assessment tools to reduce costs and improve efficiency. One way to do so has been the deployment of healthcare kiosks in medical

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institution settings[6]. In line with global advances in information technology, the quality of perioperative medicine is being improved and healthcare kiosks have been introduced as computerized pre-operative self-assessment systems[7,8].

There is evidence that the effectiveness of the information and questionnaires delivered by kiosks versus paper is equal or even more effective than paper[9]. Moreover, there seems to be no "technophobic" reluctance to use computerized systems even by senior users, as many are already familiar with touchscreens[10,11].

However, there are still scarce data on the use of kiosks as an integrated or independent part of the anaesthesia pre-operative evaluation process.

The hypothesis of this study was to test whether an electronic self-assessment questionnaire could effectively capture the patient's medical history and clinical condition and, as such, assess overall preoperative risk as reliably as a traditional anesthetic evaluation based on the American Society of Anesthesiology physical status (ASA-PS).

Methods

This retrospective pilot study was conducted in our tertiary hospital between May 2017 and July 2017. Ethics approval to review patients' data was provided by the local Ethics Committee of Cliniques Universitaires Saint Luc, UCL Louvain Brussels, Belgium (237-B 403/201318880) on March 2021, (Chairperson Prof. J-M Maloteaux).

Traditionally, in our institution, an anaesthesia trainee under the supervision of an attending anaesthesiologist conducts the pre-anaesthetic assessment via a face-to-face interview with the patient.

For the purposes of this study, a healthcare kiosk was set in the reception area of the anaesthesia consultation waiting room and a mixed-methods approach was adopted by using the Kiosk, followed by a face-to-face visit.

Kiosk Deployment and Design

We chose a healthcare kiosk developed by BeWell Innovations®, a growing digital health and MedTech Belgian company, on the market since 2010 (https://www.bewellinnovations.com). The BeWell Platform was conformed with the medical device regulation based on the Belgian legislation paragraph 10 of the royal decree of March 18th 1999 concerning medical devices and has been registered by the Federal Agency for Medicine and Health Products.

The healthcare kiosk was fitted with the latest FDA approved medical devices, and was suited to be comfortable, self-contained, and secure. The design ensured data entry independent of keyboard use through a touchscreen computer interface, and an ID-reader and a printer was added by the manufacture.

Finally, the interior of the kiosk contained the following integrated biometric readers: scale built into the floor for measuring the patient's weight, a Body Mass Index calculator, an adapted blood pressure cuff, and a pulse oximeter that measured peripheral blood oxygen saturation (Fig. 1).

Kiosk self-assessment questionnaire development

The study team included five attending anaesthesiologists with a minimum of three years' experience in anaesthesia and specific experience in pre-operative anaesthesia assessment.

After a careful review of the already existing items of standard pre-anaesthetic health assessment by paper and an extensive review of relevant literature, a first version of questionnaire was designed by the five involved anaesthesiologists. The draft was then presented to twenty-six attending anaesthesiologists from our department for evaluation, feedback, and validation.

With the collective feedback obtained, the working group determined the most clinically relevant domains and corresponding items to be included in the final version of the questionnaire. Finally, the electronic version of the questionnaire, built of 20 comprehensive items was embedded into the kiosk platform in French and Dutch languages (Fig. 2).

The questions included important elements in pre-operative assessment and were meant to distinguish relatively healthy patients from patients who needed more intensive evaluation before surgery. However, the kiosk software was not configured to automatically generate the ASA physical status (ASA-PS) score. Hence, the ASA-PS score was estimated by the study team, who took into consideration the total number of positive answers of kiosk self-assessment questionnaire, since the kiosk did not generate the ASA-PS score itself.

The Kiosk's ASA-PS score was then compared in terms of accuracy with the ASA-PS score estimated by the anaesthesia physician during the routine face to face pre-operative assessment.

Patients

The inclusion criteria for this study were:

- patients aged over 18 years old;
- patients able to read and understand French or Dutch;
- patients alert and lucid;
- patients already scheduled for the preoperative visit with an anesthesia caregiver not involved in the study;

Fig. 1 — BeWell Kiosk model simillar to the one used in the study.

1. Day-to-day, do you have difficulties climbing stairs? Y/N
2. Are you taking any medication regularly (e.g., for heart condition, high blood pressure, lungs medication, diabetes mellitus, thyroid medication, seizure)? Y/N
3. Have any of your family members encountered problems with anaesthesia? Y/N
4. **Women only:** Is there any chance that you would be pregnant at the time of anaesthesia? Y/N
5. Are you on any medication to avoid blood clotting like **Aspirin**, Direct Oral Anticoagulants e.g Dabigatran (**Pradaxa**®), Rivaroxaban (**Xarelto**®), or Acenocoumarol (**Sintrom**®)? Y/N
6. Have you ever presented any severe allergic reaction to food or to any medication? Y/N
7. Are you allergic to latex (e.g gloves, balloons, condoms…)? Y/N
8. Have you previously experience any problem with anaesthesia? Y/N
9. Do you suffer from asthma? Y/N
10. Have you had any asthma attack in the last month? Y/N
11. If the answer to question 10 is **yes**, have you experienced asthma symptoms during the night more than once a week? Y/N
12. If the answer to question 10 is **yes**, have you experienced asthma symptoms during the night more than twice a week? Y/N
13. Do you suffer from sleep apnoea? Y/N
14. Have you ever experienced severe bleeding after minor trauma that needed a surgical cauterisation? Y/N
15. Do you easily show bruises? Y/N
16. Have you ever suffered from severe bleeding after minor surgery such as appendectomy, tonsillectomy …? Y/N
17. Have you ever suffered from severe bleeding after dental extraction? Y/N
18. Do you or any member of your family have any bleeding disorders? Y/N
19. **Women only**: have you ever had to see a doctor for severe bleeding during your period? Y/N
20. **Women only**: have you ever suffered from severe bleeding after delivery? Y/N

Fig. 2 — Kiosk self-assessment questionnaire.

- elective non cardiac surgery and procedural sedation.

The exclusion criteria were patients younger than 18 years old; patients requiring cardiac surgery, and emergencies.

After being briefly instructed about the course of events, the patients were first assigned to the kiosk before being interviewed by the anaesthesiologist in charge of the pre-anaesthetic assessment.

Although the process was simple and intuitive, a nurse who remained outside the kiosk, oversaw, and assisted whenever help was needed.

To start the session the patient sat down in the kiosk, subscribed with his ID-Card, and followed the steps displayed on the touchscreen.

Further content selection was displayed on the touchscreen and the patient was able to access the anaesthesia self-assessment questionnaire.

Ultimately, the patient's measurement results were automatically printed on paper and the system turned back to its initial state of use signalizing that the process was finalized.

All participants were then invited to proceed with the conventional anaesthesia pre-operative evaluation with an anaesthesiologist. The results of this face-to-face interview were recorded in the patient's electronic file.

The health caregiver performing the patient pre-operative assessment was blinded to kiosk results until the end of the consultation.

To validate the electronic questionnaire tailored for the kiosk, each anaesthesiologist involved in face-to-face interview, was asked to rate the ASA-PS calculated by themselves based on the physical examination and on patients' medical history.

Interrater reliability was assessed using ASA-PS grades generated from two sources: the conventional pre-operative assessment of ASA-PS and the ASA-PS score estimated retrospectively by an anaesthesiologist from the study team who considered the total number of positive answers from the kiosk self-assessment questionnaire.

Statistical analysis

Data are presented as numbers (%) and median (Interquartile Range). Agreement between both ASA-PS score sources was analysed using Cohen's Kappa test (K).

The sample size calculation was based on previously published guidelines on the minimum sample size requirements for Cohen's Kappa[12].

Considering that there are four ASA categories and taking into consideration that a theoretical Kappa = 0.5 would not be accepted compared to a Kappa = 0.6 and with a power of 80% and an alpha set at 0.05, a minimum of 317 subjects were required.

We decided to include at least 320 patients to account for any eventual missing data.

Results

A total of 323 patients scheduled for non-cardiac surgery were included from May 2017 to July 2017 (Fig. 3).

Table I illustrates patients' characteristics and surgical risk. The percentage of female and male patients was similar. Table 1 also shows the BMI (Body Mass Index) estimation and the types of comorbidities in the studied population. Among the 323 patients, healthy but obese (BMI = 30 – 35 kg/m2) were considered ASA-PS II.

The abnormal BMI percentile for age (BMI = 30 - 35) was identified in 49 (15.2%) patients while 21 (6.5%) had BMI >35. The risk of "up-coding" ASA-PS classification assignments in these patients with greater BMI was non-significant.

Table II shows the type of surgery for which the patients were scheduled.

Table III illustrates the distribution of ASA-PS score assigned based on the kiosk answers and the ASA-PS score estimated by the anaesthesiologist involved in the preoperative assessment. The proportion of the agreement had a K value of 0,628 ($P< 0.001$).

Discussion

In the present study we demonstrated that the use of simple 20-items questionnaire through a health kiosk shows good agreement in providing ASA-PS compared to one provided by an anaesthesiologist.

Introducing a health kiosk that enables safe and efficient pre-operative assessment of low-risk patients would allow a better use of the workforce by focusing the anaesthesiologist's expertise and time on the most complex situations.

Whilst the potential cost-benefit and time saving of an initiative such as health kiosk are evident, it is also important to highlight the patient overall acceptance for this type of pre-operative assessment.

Given the amount of waiting and queuing that can be involved in a pre-operative visit, any time saving for patients and clinicians can ultimately lead to greater patient satisfaction and more efficient healthcare teams' work. However, through this retrospective pilot study we did not evaluate patients' satisfaction, neither the cost-benefit implied with the use of health kiosk.

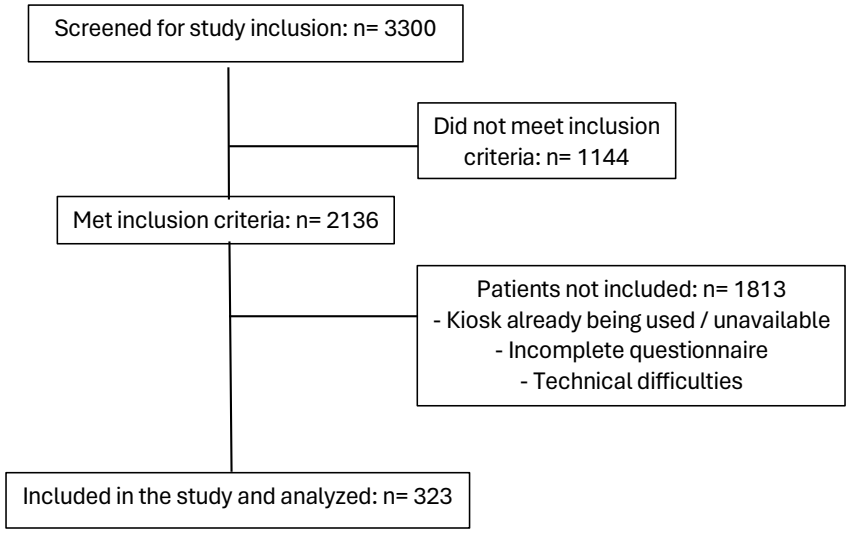

Fig. 3 — Flowchart of the study.

Table I. — Patients' characteristics and surgical risk stratification as published by the European Society of Anaesthesiology.

Age (y) median (P25-P75)	43 (31-58)
Sex F; N (%)	160 (49.5)
BMI >30; N (%)	49 (15.2)
BMI >35; N (%)	21 (6.5)
Hypertension; N (%)	43 (13.3)
Ischemic heart disease; N (%)	5 (1.5)
Atrial fibrillation; N (%)	4 (1.2)
Diabetes mellitus; N (%)	15 (4.6)
Asthma; N (%)	14 (4.3)
COPD; N (%)	4 (1.2)
Smoking; N (%)	46 (14.2)
Surgical risk; N (%)	
High	6 (1.9)
Intermediate	130 (40.2)
Low	187 (57.9)

Table II. — Type of surgeries.

	N (%)
General surgery	73 (22.6)
Gynecology	46 (14.2)
Urology	21 (6.5)
Orthopedics	66 (20.4)
Neurosurgery	11 (3.4)
ENT	50 (15.5)
Stomatology	24 (7.4)
Ophthalmology	11 (3.4)
Plastic surgery	15 (4.6)
Interventional radiology	5 (1.5)
Vascular surgery	1 (0.4)

Table III. — ASA estimated by the Kiosk answers and by the anesthesiologist involved in the preoperative visit.

ASA score	Kiosk based; N (%)	Visit based; N (%)
I	169 (52.3)	144 (44.6)
II	140 (43.3)	160 (49.5)
III	13 (4.0)	18 (5.6)
IV	1 (0.3)	1 (0.3)

In this work, we specifically validated a self-assessment questionnaire designed for kiosk to evaluate its accuracy in estimating the ASA -PS.

ASA-PS evaluation has been known to be rater-dependent for several reasons enlightening that the definition of "moderate", "severe" or "continuous life-threatening" condition remains ambiguous. Previous studies have reported a wide interrater variability indicating a high subjectivity during ASA-PS determination. In 2002, Mak et al. studied the interrater variability in determining ASA-PS based on case scenarios among anaesthesiologists with different levels of training. Their study showed that even among the most qualified of them, there was only a fair agreement, with Kappa scores between 0.21 and 0.4[13]. Cuvillon et al. in 2011 demonstrated similar results though the agreement was higher with a Kappa score of 0.53 (moderate agreement)[14]. In 2014 Sankar et al. studied the agreement in ASA-PS evaluation between two anaesthesiologists both implicated in the patient's clinical pathway and obtained a Kappa score of 0.61 (moderate agreement)[15].

More recently, a study by Goodhart et al. (2017) developed and validated an electronic pre-operative self-assessment questionnaire.

In the process, they compared the agreement between ASA-PS based on a pre-operative

assessment and ASA-PS determined by their 124-items questionnaire and obtained more than 65% of agreement[5]. Showing similar level of agreement with a Kappa score of 0.628, the 20-items questionnaire we developed can be considered significantly valid.

In previous studies, the investigators used long, laborious questionnaire to best capture the patient physical status. In the present study, we limited the questionnaire to 20 most eloquent items tailored to enhance the positive patient acceptance of digital health assessment and ease of use.

Our findings suggest that the 20-items questionnaire embedded in kiosk could be used as an easy and patient-self-administered triage point to determine a likely ASA-PS.

Based on kiosk evaluated ASA-PS, the patient could then be scheduled to nurse assessment in first intention if he or she belonged to an ASA PS class I. If the ASA-PS evaluated by Kiosk is class II or more, the patient would rather be oriented to a standard and longer pre-operative assessment by a trained anaesthesiologist. A randomized study of 1992 conducted by Twersky et al. showed that healthy patients (ASA PS class I-II) do not benefit from a pre-operative appointment with an anaesthesiologist regarding postoperative complications, patients' satisfaction, or anxiety level[16].

Nevertheless, our study has several limitations.

First, this study was limited to 323 patients seen over a period of 3 months. Although in our hospital the number of pre-operative visits may approach 300 patients per week, one of the challenges was maintaining the kiosk functional, which drastically reduced the number of utilizations per week during the trial.

Secondly, we have observed a significant reduction in the number of correctly completed sessions. Some of the patients were called for their appointments with the anaesthesiologist before completing their kiosk session. Others encountered difficulty to navigate alone through the kiosk sessions. At this point, we considered using a nurse who oversaw and assisted whenever help was needed. However, this nurse was not always available.

Another limitation was the use in the conventional pre-operative assessment of anaesthesia trainees in all years of training leaving room for bias in ASA-PS classification.

Finally, the potential inconvenience for the kiosk model that we used, was that the implemented software was not able to provide the ASA-PS automatically at the end of the session.

Further studies are thus needed to better evaluate the utility of Kiosk in the preoperative evaluation of the patients.

In conclusion, the present study demonstrated that medical systems such as a kiosk could be used as a reliable and valid tool in assessing and predicting patient's ASA-PS.

The implementation of 20-items questionnaire through a health kiosk allows more low-risk patients to be pre-operatively assessed without a proportional increase in service cost and without any negative impact on patient satisfaction. This would allow hospitals to focus their resources on optimizing care for medically complex patients.

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Conflicts of interest: None.

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