

# Evaluation of healthcare professionals' acceptance of digital intraoperative hemodynamic data recording using the technology acceptance model

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## Ethics Committee Approval

The study was approved by the Necmettin Erbakan University Ethics Committee with decision number 2024/5088, dated July 5, 2024. All participants' rights were fully protected, and written informed consent was obtained from each participant before inclusion in the study, in accordance with the Declaration of Helsinki. All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

## Conflict of Interest

No conflict of interest was declared by the authors.

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## Abstract

**Background/Aim:** This study aimed to evaluate a software prototype developed for the digitalization of intraoperative hemodynamic data recording and to examine healthcare professionals' acceptance of this system within the framework of the Technology Acceptance Model.

**Methods:** This single-center, cross-sectional, descriptive study was conducted in the operating room of a university hospital between January 1, 2025, and December 31, 2025. A total of 75 healthcare professionals actively involved in intraoperative patient monitoring were included. Data were collected using a Participant Information Form and the 28-item Technology Acceptance Model Scale. Statistical analyses included descriptive statistics, independent samples t-test, one-way analysis of variance, Pearson correlation analysis, and multiple linear regression analysis.

**Results:** Participants had high perceived usefulness and perceived ease of use scores, with mean (SD) values of 4.31 (0.56) and 4.23 (0.60), respectively. Age was negatively and significantly correlated with perceived usefulness ( $r=-0.348$ ,  $P=0.002$ ), indicating that perceived usefulness decreased with increasing age. Professional experience significantly differed according to perceived ease of use ( $P=0.042$ ). No significant relationship was found between perceived ease of use and perceived usefulness ( $r=0.030$ ,  $P=0.797$ ). Multiple linear regression analysis showed that age was an independent significant predictor of perceived usefulness ( $\beta=-0.025$ , 95% CI: -0.040 to -0.009,  $P=0.002$ ).

**Conclusion:** Digital intraoperative hemodynamic data recording was highly accepted by healthcare professionals. The finding that age was associated with technology acceptance suggests that generational differences should be considered during digital transformation. Automated recording systems may reduce workload and improve patient safety; however, organizational support and adequate technical infrastructure are critical for widespread implementation.

**Keywords:** anesthesia, digital health, intraoperative monitoring, technology acceptance model, hemodynamic data

## Introduction

Continuous monitoring of patients' hemodynamic parameters during the intraoperative period is a fundamental component of anesthesia management. Accurate and timely recording of heart rate, arterial blood pressure, oxygen saturation, and related variables is critically important for patient safety and clinical decision-making [1,2]. Traditionally, these data have been recorded manually; however, manual documentation is time-consuming and may be prone to errors, omissions, and data loss [2].

With the increasing digitalization of healthcare services, electronic health record systems and automated data collection solutions have become progressively integrated into clinical practice. In high-intensity environments such as operating rooms, automated data recording systems may reduce workload while improving data accuracy [3,4]. These systems allow continuous monitoring data to be recorded in an uninterrupted and standardized manner.

The adoption of new technologies in healthcare depends not only on technical adequacy but also on user acceptance. In this context, the Technology Acceptance Model (TAM) is a widely used framework for explaining technology use behavior. Developed by Davis, the model identifies perceived usefulness and perceived ease of use as the primary determinants of intention to use technology [5]. The model was later extended and validated in various fields by Venkatesh et al. [6]. Studies in health informatics have similarly demonstrated that these two variables are major determinants of technology acceptance [7].

Although numerous studies have examined user acceptance of electronic health record systems and clinical information technologies, studies evaluating user acceptance of digital intraoperative hemodynamic data recording systems remain limited. In particular, how healthcare professionals perceive automated recording systems used in the operating room environment and which factors influence this acceptance have not been sufficiently investigated. This study aimed to evaluate the effects of digital intraoperative hemodynamic data recording on healthcare professionals and to examine user acceptance of this system within the framework of the TAM. In addition, the effects of demographic and professional variables on technology acceptance were investigated.

## Materials and methods

### Ethical approval

The study was carried out after approval from the Necmettin Erbakan University Ethics Committee (decision no. 2024/5088, dated July 5, 2024). The study was conducted in accordance with the principles of the Declaration of Helsinki, and written informed consent was obtained from all participants.

### Study design

This cross-sectional, descriptive study was conducted in the operating room of Necmettin Erbakan University Faculty of Medicine Hospital between January 1, 2025, and December 31, 2025. Routine intraoperative hemodynamic monitoring was performed using the Eretna Vitascope 190 (VT19-10001) bedside monitor. A software prototype was developed using the Python programming language to retrieve data from the monitor and

automatically record measurements at predefined 5-minute intervals. Through this system, patient hemodynamic data were automatically documented and made available for reporting.

### Study population

The study population consisted of healthcare professionals actively involved in intraoperative patient monitoring and hemodynamic data recording, including faculty members, resident physicians, anesthesia technicians or technologists, and nurses. A total of 75 healthcare professionals who met the inclusion criteria were enrolled. No formal sample size calculation was performed; all eligible participants were included. Healthcare professionals who were actively working in the operating room and willing to participate were included, whereas those who declined or were not involved in the intraoperative process were excluded.

### Data collection

Data were collected using a two-part questionnaire. The first section, the Participant Information Form, assessed sociodemographic and professional characteristics, including sex, age, marital status, educational level, professional title, duration of professional experience, history of computer training, and level of computer use.

The second section consisted of the Likert-type Technology Acceptance Model Scale, which was used to evaluate attitudes toward electronic health record systems. The Turkish validity and reliability of the scale had previously been established [8]. The scale consisted of 28 items and included two subdimensions: perceived usefulness, with 14 items, and perceived ease of use, with 14 items. Each item was scored on a 5-point Likert scale ranging from 1, strongly disagree, to 5, strongly agree.

### Statistical analysis

Data were analyzed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were expressed as mean (SD) for continuous variables and number with percentage,  $n$  (%), for categorical variables. Normality was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. For comparisons, the independent samples  $t$ -test and one-way analysis of variance were used when parametric assumptions were met. Pearson correlation analysis was used to evaluate relationships between variables. Multiple linear regression analysis was used to examine the effects of age, sex, and history of computer training on perceived usefulness. Model significance was assessed using the  $F$  test, and explanatory power was assessed using  $R^2$ . A  $P$ -value  $<0.050$  was considered statistically significant.

## Results

A total of 75 healthcare professionals were included in the study. The mean age of the participants was 37.29 (10.32) years, and 47 participants (62.7%) were female. Most participants were married (74.7%) and held doctoral or associate degrees. Regarding professional distribution, 40 participants (53.3%) were allied healthcare personnel, 28 (37.3%) were resident physicians, and 7 (9.3%) were faculty members. The most common duration of professional experience was 5-10 years (45.3%). Although formal computer training was uncommon (14.7%), more than half of the participants reported their computer use level as moderate

or good. Detailed sociodemographic and professional characteristics are presented in Table 1.

**Table 1. Demographic characteristics of participants (n=75)**

Variable	Value
Age, years, mean (SD)	37.29 (10.32)
Sex, n (%)	
Female	47 (62.7)
Male	28 (37.3)
Educational level, n (%)	
Doctoral degree	35 (46.7)
Associate degree	23 (30.7)
Bachelor's degree	17 (22.7)
Professional title, n (%)	
Allied healthcare personnel	40 (53.3)
Resident physician	28 (37.3)
Faculty member	7 (9.3)
Professional experience, n (%)	
<5 years	9 (12.0)
5-10 years	34 (45.3)
10-15 years	13 (17.3)
15-20 years	7 (9.3)
>20 years	12 (16.0)
Computer training, n (%)	
Yes	11 (14.7)
No	64 (85.3)
Level of computer use, n (%)	
Very low	5 (6.7)
Low	10 (13.3)
Moderate	32 (42.7)
Good	17 (22.7)
Very good	11 (14.7)

SD: Standard deviation. Allied healthcare personnel includes nurses and anesthesia technicians/technologists.

The mean scores for technology acceptance dimensions indicated a highly positive perception of the digitalized system. The mean perceived usefulness score was 4.31 (0.56), and the mean perceived ease of use score was 4.23 (0.60). These high values suggest that the software prototype was regarded as functional and user-friendly within the clinical workflow (Table 2).

**Table 2. Descriptive statistics of technology acceptance variables**

Variable	Mean (SD)	Minimum-maximum
Perceived usefulness	4.31 (0.56)	1.00-5.00
Perceived ease of use	4.23 (0.60)	1.00-5.00

SD: Standard deviation. Scores are based on a 5-point Likert scale.

Statistical comparisons showed that professional experience had a significant effect on perceived ease of use ( $F=2.629, P=0.042$ ), whereas its effect on perceived usefulness was not statistically significant ( $P=0.127$ ). The level of computer use showed a trend toward significance for perceived usefulness ( $F=2.393, P=0.059$ ) but did not significantly affect perceived ease of use ( $P=0.809$ ). No statistically significant differences were observed in perceived usefulness or perceived ease of use scores according to sex or history of computer training ( $P>0.050$ ).

Correlation analysis identified a significant negative relationship between age and perceived usefulness ( $r=-0.348, P=0.002$ ), indicating that perceived usefulness of the digital system decreased as age increased. However, age was not significantly correlated with perceived ease of use ( $r=0.017, P=0.884$ ). No significant association was found between perceived usefulness and perceived ease of use ( $r=0.030, P=0.797$ ), contrary to the standard assumptions of the TAM (Table 3).

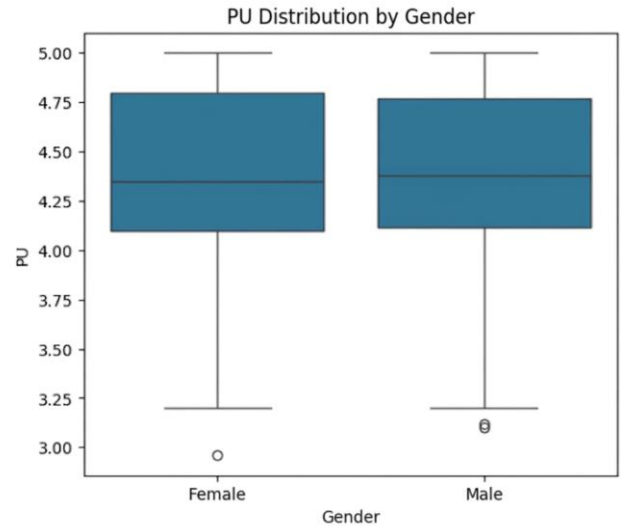
**Table 3. Relationships between demographic variables and technology acceptance components**

Variable	Age	Perceived usefulness	Perceived ease of use
Age	—	-0.348 ( $P=0.002$ )	0.017 ( $P=0.884$ )
Perceived usefulness	-0.348 ( $P=0.002$ )	—	0.030 ( $P=0.797$ )
Perceived ease of use	0.017 ( $P=0.884$ )	0.030 ( $P=0.797$ )	—

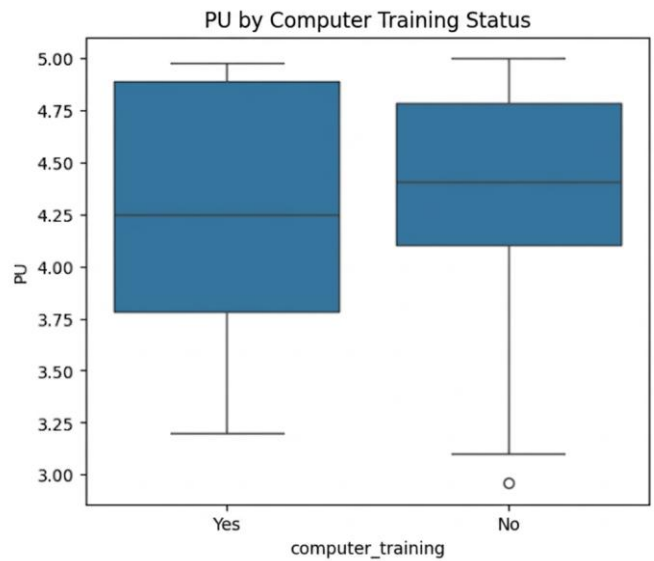
Values are Pearson correlation coefficients with corresponding  $P$ -values.

The multiple linear regression model, which included age, sex, and computer training, was statistically significant ( $F=4.016, P=0.011, R^2=0.145$ ). Among the predictors, only age was an independent and significant determinant of perceived usefulness ( $\beta=-0.025, 95\% \text{ CI: } -0.040 \text{ to } -0.009, P=0.002$ ). Sex and computer training did not significantly contribute to the explanatory power of the model. The distributions of perceived usefulness according to sex and computer training status and the relationship between age and perceived usefulness are presented in Figures 1-3.

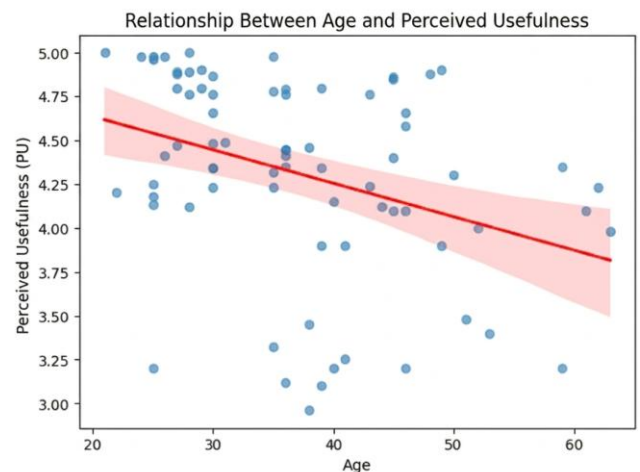
**Figure 1. Distribution of perceived usefulness by sex.**



**Figure 2. Perceived usefulness according to computer training status.**



**Figure 3. Relationship between age and perceived usefulness.**



## Discussion

In this study, the system developed for digital intraoperative hemodynamic data recording demonstrated a high level of acceptance among healthcare professionals. The high scores for perceived usefulness and perceived ease of use indicate that the system was regarded as both functional and user-friendly in clinical practice. These findings are consistent with recent literature highlighting the rapid adoption of digital tools in high-stakes clinical environments [9,10]. However, the unique nature of the intraoperative setting distinguishes these results from general electronic health record studies. Unlike standard ward documentation, the operating room requires rapid decision-making under substantial time pressure, particularly during critical phases such as induction and emergence from anesthesia. Automated recording systems directly address these high-workload moments by reducing the need for manual charting and allowing clinicians to maintain their focus on patient physiology rather than documentation [1,3].

One of the most important findings was the negative association between age and perceived usefulness. Although older clinicians did not appear to perceive the system as difficult to use, they rated its utility less favorably than younger participants. This finding suggests that technology acceptance among senior staff may be influenced by established clinical habits and long-standing reliance on traditional manual methods [6]. Therefore, digital transformation strategies in hospitals should not focus only on technical training but should also emphasize the specific clinical benefits and safety improvements of the system to bridge this generational gap in perceived utility.

Another key finding was the significant difference in perceived ease of use according to professional experience. This result suggests that familiarity gained through clinical practice, rather than formal computer training alone, may shape how intuitively a professional interacts with new medical software. While younger professionals may adapt quickly to digital interfaces, more experienced staff may evaluate ease of use through their deep understanding of clinical workflow. This interpretation is supported by the finding that formal computer training had no significant effect on acceptance, reinforcing the importance of user-centered design that reflects clinical reality rather than relying solely on prior technical instruction.

Contrary to the core assumptions of the TAM, perceived ease of use was not significantly associated with perceived usefulness [5]. This lack of correlation may be explained by a ceiling effect, as the high mean scores for both variables may have narrowed the variance and limited the ability to detect a statistical relationship. In addition, in specialized environments such as the operating room, the usefulness of a tool may be judged primarily by its immediate contribution to patient safety and data accuracy rather than by interface simplicity. For a clinician managing a complex case, a system's ability to prevent data loss and standardize records may outweigh the importance of its ease of operation.

The developed prototype offers potential clinical advantages, including reduced manual documentation errors and improved record standardization. By providing continuous data at 5-minute intervals, the system can generate a high-fidelity clinical record that may be difficult to achieve through manual entry [4].

However, the limited explanatory power of the regression model suggests that other external factors, such as organizational support, technical infrastructure, and the cognitive load of the environment, may also play important roles in technology adoption. Future research should incorporate these organizational variables to provide a more comprehensive understanding of digital transitions in anesthesia.

## Limitations

This study has several limitations. First, the single-center design and relatively small sample size may limit the generalizability of the findings to different hospital settings or larger healthcare populations. Second, because data were collected through self-report measures, response bias cannot be entirely excluded; participants' perceptions may not fully reflect their actual clinical behavior. Third, the cross-sectional design precludes causal inference. In addition, the high mean scores for technology acceptance dimensions may have created a ceiling effect, potentially masking the statistical relationship between perceived ease of use and perceived usefulness. Finally, the model included only a limited number of demographic variables; other potential determinants, such as daily workload intensity, duration of technology exposure, and organizational support, were not evaluated. Future multicenter investigations with longitudinal follow-up and broader variable sets would strengthen the evidence base.

## Conclusion

This study showed that a prototype for digital intraoperative hemodynamic data recording was well accepted by healthcare professionals. High perceived usefulness and perceived ease of use scores indicate that the system is practical and user-friendly in the operating room. Age negatively affected perceived usefulness, highlighting the need to consider generational differences in digital adoption. The lack of a relationship between perceived ease of use and perceived usefulness suggests that clinical value may depend more on functionality and safety than on simplicity alone. With appropriate infrastructure and organizational support, such systems can improve efficiency and patient safety.

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