

## ANALYSIS OF THE EFFICIENCY OF DOUBLE E-BARCODE STICKERS ON THE COST AND TIME OF STERILIZATION AT SOEDONO HOSPITAL

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### ABSTRACT

Surgical procedures and invasive procedures in hospitals require the availability of sterile medical instruments and materials in varying quantities and types. However, the trend of increasing healthcare-associated infections (HAIs) remains a major challenge in healthcare facilities. In order to improve the efficiency and quality of service, dr. Soedono Hospital, East Java Province developed the use of a double e-barcode sticker outer indicator as a new labeling system in the sterilization process of medical devices. This study aims to evaluate the influence of the labeling system on the cost and time aspects of sterilization. The research was carried out quantitatively with a comparative design, utilizing secondary data of 200 samples obtained from the sterilization process from 2023 to 2024. The sample consisted of surgical instruments and consumable medical materials sterilized using steam and plasma methods. Data analysis was carried out using Mann-Whitney non-parametric statistical tests to test the difference between the old method and the e-barcode method. The results showed that the application of the double outer indicator of e-barcode stickers did not have a significant impact on sterilization costs ( $p=0.138$ ), but it was proven to significantly accelerate the sterilization process time ( $p=0.000$ ). These findings conclude that although costs have not changed much, the time efficiency gained supports improved operational performance, reduced staff workload, and improved patient safety through better tracking and documentation.

**Keywords:** E-Barcode, External Indicator, Sterilization, Cost, Time.

### INTRODUCTION

Hospitals as health service facilities have a big responsibility in ensuring patient safety. One of the crucial aspects in maintaining the quality of service is to ensure that all medical instruments used have gone through a proper and well-documented sterilization process. *Healthcare-associated infections* (HAIs) are still a global challenge, with prevalence reaching more than 7% in developing countries and

leading to an increase in the cost burden and length of hospitalization (Haque et al., 2017; WHO, 2016). In Indonesia, the sterilization process is generally carried out in the Central Sterile Supply Department (CSSD) unit, which is responsible for cleaning, disinfection, sterilization, and distributing equipment to various service units. In this process, the use of sterile indicators is essential to show that a tool has

passed the sterilization procedure correctly. These indicators are divided into two types, namely internal chemical indicators and external indicators. External indicators conventionally still use manual methods such as autoclave tape or label guns (Basu et al., 2015; Cahyani, 2019).

However, manual systems have various limitations, such as the lack of information listed, the risk of recording errors, and the lack of the ability to be traced. Along with the development of digital technology in the health sector, innovations have emerged in the form of a **double e-barcode sticker outer indicator**, which is equipped with a scannable QR code. This e-barcode contains information on the unit of equipment owner, sterilization date, expiration date, and batch number that can be recorded digitally (Prakoso & Fadhilah, 2022). The use of the e-barcode system is considered superior to manual methods because it can support legal documentation, speed up the labeling process, and increase efficiency in tracking tools (Yuliasari, 2021; Rasyid, 2020). This system also allows the application of double stickers, where one sticker is affixed to the packaging of the device, and the second sticker can be affixed to the patient's medical record as proof of sterility documentation. This not only supports the safety aspect of patients, but also facilitates the audit process of hospital accreditation by the Hospital Accreditation Commission (KARS, 2022) and international standards such as JCI (2018).

In terms of operational efficiency, previous studies have shown that digital systems such as e-barcodes can reduce work time, speed up distribution, and reduce the potential for human error

(Manullang, 2020; Setyaningsih, 2021). However, there is an assumption that the application of this technology actually increases the cost burden, especially in terms of procurement of special stickers and supporting devices. Therefore, it is necessary to conduct an objective analysis to assess whether this system really provides efficiency benefits both in terms of time and cost.

This research was conducted at dr. Soedono Hospital, East Java Province, as an educational type B referral hospital, which has partially implemented the e-barcode system since 2023. Based on data from the Central Sterilization Installation (ISS), there are two labeling systems that run in parallel: the conventional (manual) system and the e-barcode sticker double indicator system. Therefore, this study is important to analyze the comparison between the two systems from the perspective of **cost and time efficiency**, as well as to provide recommendations for the implementation of the optimal and standardized system. This study aims to analyze the cost difference between the use of conventional external indicators and e-barcode sticker double indicators and analyze the difference in labeling and documentation process time between the two systems.

## LITERATURE REVIEW

Sterilization is an important process in ensuring the safety of medical procedures, with the use of indicators as a marker of the achievement of sterile conditions. This indicator is divided into internal and external indicators. A commonly used external indicator is autoclave tape or manual labels (Basu et al., 2015). Although this method is easy to implement, the disadvantage lies in the limitations of information and

the absence of digital records. Cahyani (2019) added that external indicators that are not digitized make it difficult to track sterility in the event of an incident or audit.

The e-barcode system is an innovation in medical device labeling that contains information in the form of unit names, sterilization dates, expiration dates, and batch numbers digitally (Cahyani, 2019; Yuliasari, 2021). This system generally uses double stickers, one for the device and one for the patient's medical record, thus increasing the validity of the documentation. Prakoso & Fadhilah (2022) show that the application of e-barcodes in CSSD has a significant effect on improving the accuracy of tracking tools. WHO (2016) also recommends digital documentation as part of effective infection control practices in health facilities.

Errors in the sterilization and documentation process can have a direct impact on patient *safety*. Haque et al. (2017) revealed that healthcare-related infections (HAIs) are still the main cause of morbidity in hospitals, and one of the factors is unverified sterile medical instruments. The e-barcode sticker double system provides legal and traceable evidence of sterility documentation, thereby strengthening legal protection in patients' medical records (Susanto & Kartika, 2020). Hughes (2008) also emphasized the importance of accurate sterile documentation to prevent medical errors and litigation. Sanders & McCormick (1993) emphasized that ergonomically designed technology not only speeds up work but also reduces fatigue and operator error. For this reason, CSSD officer training in using the e-barcode system is very crucial. Prakoso & Fadhilah (2022) also suggest periodic training to

maintain consistency in using the system. Without adequate competence, digitalization will not provide optimal results.

## RESEARCH METHODS

This study uses a quantitative approach with a comparative method, which aims to compare two sterilization indicator systems based on cost and time efficiency. The design of this study uses a combination of simple random sampling and total sampling techniques, with the data source coming from the Central Sterilization Installation (ISS) of dr. Soedono Madiun Hospital. The population in the study includes all surgical instruments and consumable medical materials (BMHPs) that have undergone the sterilization process during the period from 2023 to 2024. From this population, 200 data units were sampled, consisting of 100 units using traditional external indicators (such as autoclave tape and label guns), and another 100 units using the e-barcode sticker double indicator system.

This study examines two main variables, namely the type of sterilization indicator as an independent variable (divided into traditional systems and e-barcode systems), and dependent variables in the form of sterilization costs and the time of implementation of the sterilization process. The data normality test is carried out first to determine the distribution of data. Given the characteristics of the data are not normally distributed, the analysis is followed by the Mann-Whitney test to determine whether there is a statistically significant difference between the two groups of indicators in terms of cost and sterilization time.

## RESAERCH RESULT

Table 1. Normality Test Results of Cost and Time Data

Variabel	N	Kolmogorov Smirnov Z	P-Value
Cost	200	0.314	0.000
Time	200	0.384	0.000

Source : Primary data processed, 2025

Based on table 1, the results of the normality test using the Kolmogorov-Smirnov test show that both the cost data ( $p = 0.000$ ) and the time data ( $p = 0.000$ ) are not

normally distributed. This necessitates the use of non-parametric methods for further analysis, ensuring the validity of the results obtained.

Table 2. Results of the Mann-Whitney Test between the outer indicator and the double *e-barcode* sticker against the Cost

	Cost
Mann-Whitney U	4403
With	-1.482
P-value	0.138

Source : Primary data processed, 2025

Based on table 2, the p-value for charge is  $p = 0.138$  indicating no significant influence in cost between instruments that use the e-barcode sticker double outer indicator and those that do not. This suggests that,

although there is a potential increase in initial costs for the implementation of *e-barcode double self-adhesive labels*, the effect on operational costs is not significant.

Table 3. Mann-Whitney Test Results between the outer indicator and the double *e-barcode* sticker against Time

	Time
Mann-Whitney U	414.5
With	-12.215
P-value	0.000

Source : Primary data processed, 2025

Based on table 3, the p-value for cost is  $p = 0.000$  indicating a significant influence in time between instruments that use e-barcode double self-adhesive labels and those that do not. The

application of e-barcode double self-adhesive labels has been proven to speed up the sterilization process, which is very important in improving operational efficiency in hospitals.

## DISCUSSION

The application of the e-barcode double sticker external indicator system in the sterilization process in hospitals shows a number of real benefits in terms of efficiency, patient safety, and service quality. Facts in the field show that this system is able to present data digitally and accurately, such as sterilization dates, expiration dates, and the identity of the ordering unit. The e-barcode label consists of two parts, one is affixed to the packaging of sterile medical devices, while the other can be used as documentation in the status of the patient's medical records. With this system, the documentation process becomes neater, faster, and easier to trace. Although the price per sticker e-barcode is slightly more expensive than conventional methods (e.g. autoclave tape), the use of this system has been shown to reduce manual workload, speed up the labeling process, and reduce the risk of data input errors. Hospitals can also recall nearly expired devices faster because monitoring is done in real-time through a barcode scanning system.

Theoretically, the importance of automation in repetitive activities such as sterilization is supported by the statement of Sanders and McCormick (1993), who mentioned that automation can improve work accuracy and reduce human error. In the context of cost efficiency, Horngren, Foster, and Datar (2006) affirm that the use of technology will help to significantly lower fixed and variable costs. Furthermore, according to Haque et al. (2017), one of the main causes of nosocomial infections or *Healthcare-Associated Infections (HAIs)* is the use of tools that are not sterile or cannot be verified for their sterility status. In this case, the e-barcode system

serves as an accurate and accountable verification solution. Cahyani (2019) also stated that digital management of medical equipment will be a major need along with the increasing complexity of services in modern hospitals. This is relevant to the double sticker system, which not only simplifies the administrative process, but also strengthens *evidence-based documentation*, an important aspect of both national (KARS) and international (JCI) accreditation processes.

Based on the facts and theoretical support that has been presented, it can be stated that the implementation of the e-barcode system provides significant long-term benefits, although it requires initial investment costs. From an operational efficiency perspective, hospitals can save time and effort in the documentation process, while reducing the potential for administrative errors. In terms of patient safety, this system strengthens the principle of *patient safety* because it allows for well-documented sterility verification. Furthermore, the system also has legal value, as a single label can be physical evidence in the patient's status that can be traced back in the event of an audit or clinical investigation. Therefore, the e-barcode double sticker outer indicator system is not only suitable for use as a technical solution in sterilization, but also worthy of being considered as a new standard in supporting the quality, efficiency, and reputation of hospital services.

## CONCLUSIONS

Based on the results of data analysis in this study, it can be concluded that the use of double e-barcode sticker external indicators

in the sterilization process at dr. Soedono did not show a significant difference in costs when compared to traditional labeling systems. This shows that economically, the new system does not overload the budget. However, there is a significant difference in the time aspect, where the e-barcode system has been proven to be able to speed up the labeling and sterilization documentation process. Thus, the system provides real time efficiency advantages, which are critical in hospital operations. In addition, the e-barcode system is also in line with efforts to digitize health services because it supports more accurate documentation, is easy to trace, and is in accordance with hospital accreditation standards.

#### SUGGESTION

Based on the conclusions obtained, it is recommended that dr. Soedono implemented a comprehensive e-barcode sticker double outer indicator system in the sterilization process of medical devices, replacing the manual labeling system that has been used so far. The full implementation of this system will increase work efficiency and strengthen security and accountability aspects in services. In addition, it is necessary to conduct regular training for Central Sterile Supply Department (CSSD) officers so that they are able to operate the e-barcode system optimally and consistently. Improving human resource competencies will support the successful implementation of this system in a sustainable manner. No less important, hospitals are also advised to develop a system that is integrated with the Hospital Management Information System (SIMRS), so that the tracking of sterile medical devices can be done digitally, quickly, and transparently,

starting from the sterilization process to its use in service units.

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