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# Factors Affecting Health Information System Quality: Can Top Management Support Be a Moderator?

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**Research aims:** This study aims to examine the factors that influence the quality of health information system (HIS) in hospitals in Bandung City and top management support as a moderating variable.
**Design/Methodology/Approach:** This research method is a survey. Eighty-three users of HIS in hospitals participated as respondents. Hypotheses were tested using the partial least squares structural equation modeling (PLS-SEM) method.
**Research findings:** The study results exhibited that software quality did not affect the health information system quality, even if it was moderated by top management support. While user competence significantly impacted health information system quality, top management support would strengthen the influence between user competence and health information system quality.
**Theoretical contribution/Originality:** This study presents a conceptual framework for HIS quality, with a specific emphasis on the role of top management support.
**Practitioner/Policy implication:** This study recommends that HIS should have interoperability. Additionally, there is a need for government policy support at both central and regional levels to ensure that the hospitals' top management demonstrates a real commitment and contribution.
**Keywords:** Health Information System; Hospital; Software Quality; User Competence; Top Management Support

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## Introduction

The quality of information systems is one of the fundamental aspects of an organization because the decision-making process will be easier to carry out with a quality information system (Hall, 2011). The right decision will undoubtedly encourage companies to be more productive and competitive with competitors (Abood, 2019; Nour et al., 2022). A quality information system consists of elements that are mutually integrated and work in harmony with one another (Susanto, 2017). When all elements and sub-systems are integrated, an information system can be relied upon by an organization to achieve its goals (Soudani, 2012).

Fundamentally, information systems are utilized by many organizations, ranging from profit-making organizations *(profit-oriented)* to non-profit organizations. Information systems produce many diverse types of information, such as financial information and non-financial information, both of which are vital for an organization (Budiarto et al., 2019).

Specifically, the hospital is one of the organizations that certainly needs to have a quality information system. A quality information system will support all forms of administrative and non-administrative processes at the hospital (Mulyani, 2016). Information systems can add organizational value with accurate, relevant, and timely information. As a result, operations at the hospital can run effectively and efficiently and can improve

the evaluation and control of service costs at the hospital (Mulyani, 2016). By having a good and reliable health information system, hospitals can make the right decisions. Moreover, hospitals should move towards digitalization and technological development, which will ultimately encourage humanitarian efforts and achieve sustainability in terms of ensuring healthy lives and promoting well-being for all at all ages (Asi & Williams, 2018; Küfeoğlu, 2022).

Several hospitals in Bandung City, in this case, have been asked for their commitment to continue creating an integrated hospital information system so that it can improve the quality of their services. Nevertheless, the low awareness of hospital human resources in operating and supporting integrated hospital information systems in Bandung City is one of the problems that is still developing. Therefore, the Head of the Bandung City Health Office expects high commitment from each hospital and its management (Humas Dinkes, 2021). Health information system (HIS) in Bandung City must also be able to provide accurate information regarding the development of patient data when COVID-19 occurs so that it is hoped that decisions in terms of patient treatment can be handled properly (Humas Dinkes, 2021).

The other challenges are the development and integration of HIS in Indonesia. According to Razaki (2022), they include the issues of data duplication and replication between one system and another since the health information system in Indonesia is still fragmented. Problems related to the reliability of HIS also, of course, cover data security and privacy, lack of a framework for integration, lack of human resources to develop and support integrated systems, and low levels of internet connectivity (Nengomasha et al., 2018).

Certainly, development from a software quality perspective should not only strive to create a high-quality information system but also ensure accuracy in decision-making. Furthermore, software in the health sector is undeniably crucial for providing services to patients. Therefore, software must possess usability, reliability, and efficiency (Aghazadeh et al., 2014). Information system users are no less important in supporting the creation of quality information systems; competent and trained system users are required (Endraria, 2016; Nugraha et al., 2022).

The commitment and support of top management in this study act as a moderator variable. Hwang (2019) argued that top management support plays a role in supporting the successful implementation of information systems, with task interdependence as a moderating variable. The existence of top management support is expected to be a supporting aspect for software and system users to achieve reliable quality information systems for the organization. This is because top management who wants a quality information system will definitely provide support in terms of funding, time, and resources (Darma et al., 2018; Wijayanto et al., 2016).

This study was conducted at hospitals in Bandung, where the health information system faced challenges in development, particularly in terms of interoperability and integration. At the time, multiple information systems had not yet been integrated. This research, thus, aims to provide valuable insights for hospital stakeholders in Bandung who are committed to enhancing the quality of HIS. The study addresses the need for quality human resources and strong management commitment. Furthermore, the research contributes to the overall improvement of HIS in Indonesia. There are existing issues related to policies and support from stakeholders (Herawati et al., 2022). As such, it is crucial to investigate whether the support of top management, who are also hospital stakeholders, can enhance the quality of HIS in Bandung hospitals. From a theoretical standpoint, the role of top management support as a moderating variable will complement the literature on HIS. In comparison, previous research often treated top management support as an independent variable (Darma et al., 2018; Meiryani, 2014).

## Literature Review and Hypotheses Development

### Health Information System (HIS)

HIS comprises interconnected structures encompassing data, information, indicators, procedures, tools, technology, and human resources. It is managed in an integrated manner to provide information support for decision-making processes, health program planning, implementation monitoring, and evaluations at all levels of health administration (Lestari et al., 2016).

The legal basis for implementing HIS in Indonesia is Government Regulation Number 46 of 2014 concerning HIS. HIS implementation includes (1) implementation of HIS, which consists of health data, health information, health indicators, data and information sources, data and information collection, data and information processing, data and information storage, information security and confidentiality; (2) HIS management; (3) HIS resources; (4) development of HIS; and (5) dissemination and use of health data and information (Peraturan Pemerintah Nomor 46 Tahun 2014 Tentang Sistem Informasi Kesehatan, n.d.)

### Delone and Mclean Information System Quality

Delone's information systems success model, also known as the DeLone and McLean model, stands out as a widely recognized framework for conceptualizing and operationalizing successful information systems. This model, initially developed by DeLone and McLean (1992), concentrates on the success of implementation at the organizational level. It delineates the causal relationships among the measurement elements of information system success. Subsequently, DeLone and McLean revised their model, evolving it into the latest iteration of information systems success (DeLone & McLean, 2003).

### TOE (Technology-Organization-Enviroment) Framework

In implementing information systems or information technology, several aspects influence the process. One of the underlying theories is the TOE Framework, which comprises technology, organization, and environment. This implies that there are technological, organizational, and environmental factors that will influence the successful implementation of innovation and technology in an organization (Awa et al., 2017). The technological aspect involves the characteristics of the technology to be applied. The organizational aspect refers to the internal aspects of the organization, while the environmental aspect encompasses the external context that will influence it. Understanding these three aspects contributes to improving the quality of decision-making in system implementation and enables the identification of potential obstacles (Obinna-Azubuike et al., 2023; Hussain et al., 2020).

### Hypotheses Development

The theoretical framework underlying this research is technology-organization-enviroment framework, and which aims to delve deeper into measuring the success of healthcare information systems. System quality, information quality, use, user satisfaction, individual impact, and organizational impact by DeLone & McLean (2003) will serve as indicators of system success. Meanwhile, software quality and user competence will act as drivers to support the success of healthcare information systems, with top management support playing a moderating role.

### Software Quality Effect on HIS Quality

Information system quality is related to five aspects: human, hardware, software, data, and network. One way to measure the quality of an information system is to find out how quickly the system (software) can process incoming data into reports and information. This is, of course, also assisted by the ability of the users of the information system; the easier it is to operate, the faster the processing of the data is so that it becomes good reports and information (Agustines & Tananjaya, 2012).

***$H_1$**: Software quality has a positive effect on HIS quality*

**Software Quality Effect on HIS Quality Moderated by Top Management Support**

For the resultant information system to attain high quality, the software employed must possess the capability to swiftly process and generate data (Agustines & Tananjaya, 2012). Jin (2002) asserts that increased support from top management enhances information system performance, and a positive correlation exists between top management support during the development and operation of information systems and their overall performance. Additionally, Jin (2002) emphasizes that heightened support from top management contributes to improved information system performance, reinforcing the positive connection between top management involvement in the development and operation of information systems.

***$H_2$**: Top management support moderate the effect of software quality on HIS quality*

**User Competence Effect on HIS Quality**

Previous research discussing the competence of system users revealed that it can influence the creation of a quality information system, including research from Utami et al. (2016). Added by Hertati and Zarkasyi (2015), the competence of system users is a crucial factor in the deployment of accounting information systems. Competence of system users affects the implementation of a quality information system (Pavlatos, 2015). Consequently, understanding the competence of information system users can support the use of information systems (Eschenbrenner & Nah, 2014).

***$H_3$**: User competence has a positive effect on HIS quality*

**User Competence Effect on Health Information System Quality Moderated by Top Management Support**

Sudarmanto (2014) and Vathanophas (2006) categorize competency characteristics into five types: (1) motives, (2) traits, (3) self-concept, (4) knowledge, and (5) skills. Concerning the utilization of information systems, Jin (2002) posits that elevated technical proficiency among information system personnel correlates with improved information system performance. Utami et al. (2016) also contend that heightened support from top management enhances information system performance, owing to a positive relationship between top management support in the development and operation of information systems. The support of top management in both the development and organization of information systems within the company increases user motivation to utilize the existing information system and fosters satisfaction with its use (Fitrios et al., 2022).

***$H_4$**: Top management support moderate the effect of user competence on HIS quality*

Based on the theoretical framework and hypothesis, the research model is depicted in Figure 1.

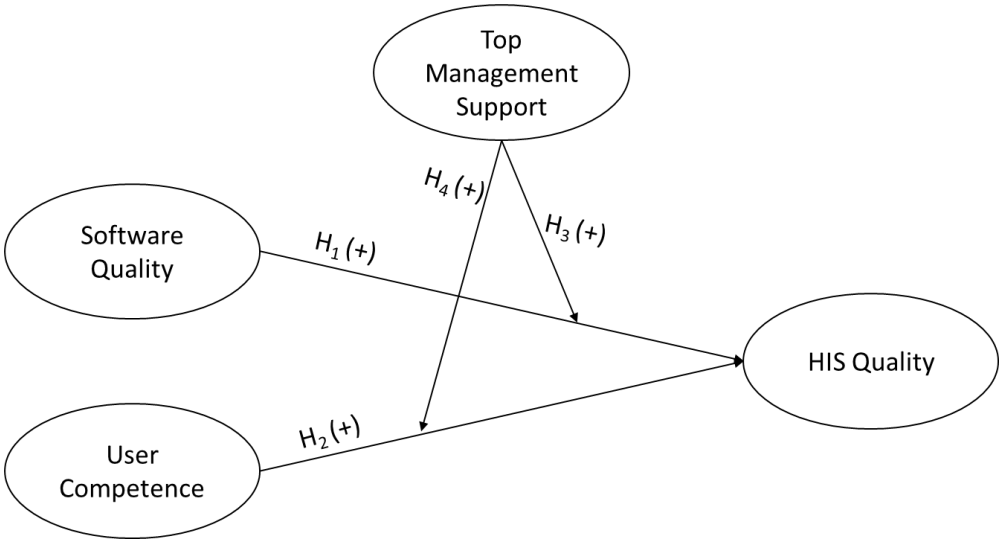


**Figure 1** Research Model

## Methodology

This study used a survey method. While the independent variables were software quality and user competence, the dependent variable was health information system quality. Meanwhile, the moderating variable was top management support. The type of data used was primary data. Data collection was carried out through a survey by compiling a list of questions addressed to respondents, namely users of HIS from medical and non-medical departments at hospitals in Bandung City registered with the Ministry of Health. The number of samples involved was 83 respondents, with a census sampling technique. Additionally, this study employed quantitative data analysis techniques, and the analysis tool utilized multiple regression analysis with the help of the SmartPLS computer program. The operationalization of the variables in this study is presented in Table 1.

**Table 1** Variable Operationalization

| Variable | Dimension | Indicators |
|---|---|---|
| Software Quality (ISO 25010, 2011) | Functional Suitability | Functional Completeness |
| | | Functional Correctness |
| | | Functional Appropriateness |
| | Performance Efficiency | Time Behavior |
| | | Resource Utilization |
| | | Capacity |
| | Compatibility | Co-existence |
| | | Interoperability |
| | Usability | Accessibility Recognizability |
| | | Learnability |
| | | Operability |
| | | User Error Protection |
| | | User Interface Aesthetics |
| | | Accessibility |
| | Reliability | Maturity |
| | | Availability |
| | | Recoverability |
| | Security | Confidentiality |
| | | Integrity |

**Table 1** Variable Operationalization (Cont.)

| Variable | Dimension | Indicators |
|---|---|---|
| | | Non-repudiation |
| | | Accountability |
| | | Authenticity |
| | Maintainability | Modularity |
| | | Reusability |
| | | Analyzability |
| | | Modifiability |
| | | Testability |
| | Portability | Adaptability |
| | | Installability |
| | | Replaceability |
| User Competence (Sudarmanto, 2014) | Motive | Doing a good job |
| | | Completing tasks in a timely manner |
| | Characteristic | Having a positive role in work results |
| | | Able to work with a team |
| | | Taking initiative at work. |
| | Self-concept | Having a broad concept of thinking |
| | | Able to handle uncertainty at work |
| | Knowledge | Understanding about the system |
| | | Knowledge of work standards |
| | | Knowledge regarding the understanding of the organization |
| | Skills | Skills in using software |
| | | Skills in using a computer |
| | | Skills in communicating |
| Top Management Support (Darma et al., 2018) | Providing human resources as needed | Suitability of work data entry personnel properly |
| | | Technical support personnel by necessity |
| | Providing hardware as needed | Compatibility of computer hardware<br>Network communication network with needs |
| | Providing software as needed | Compatibility of operating system software |
| | | Application software |
| | Providing funds as needed | Appropriateness of the amount of the budget for maintenance |
| | | Hardware and software replacement |
| | | Staff training |
| HIS Quality (Marjulin, 2019; DeLone & McLean 2003) | System Quality | Ease of use |
| | | Functionality |
| | | Reliability |
| | | Flexibility |
| | | Portability |
| | | Integration |
| | | Importance |
| | Information Quality | Accuracy |
| | | Timelines |
| | | Completeness |
| | | Relevance |

**Table 1** Variable Operationalization (Cont.)

| Variable | Dimension | Indicators |
|---|---|---|
| | | Consistency |
| | Use | Frequency of use |
| | | Time of use |
| | | Number of access |
| | | Usage pattern |
| | | Dependency |
| | User Satisfaction | Self-efficacy |
| | | Repeat visit |
| | | Personalization |
| | | Perceived risk and enjoyment |
| | Individual Impact | Individual performance productivity |
| | Organizational Impact | Cost savings |
| | | Expanded markets |
| | | Incremental additional sales |
| | | Reduced search cost |
| | | Time-saving |

## Results and Discussions

Table 2 illustrates the demographic characteristics of the respondents in this study. The majority of respondents' positions are occupied by staff from the medical department, comprising 67.50%, with males representing the largest portion at 51.80%. Moreover, most of respondents hold a bachelor's degree, accounting for 73.50%, while the duration of work experience varies significantly, ranging from 3 years to over 10 years.

**Table 2** The Demographic of Respondents

| Demographics By | Category | n | % |
|---|---|---|---|
| Respondent's Position at Hospital | Medical Department | 56 | 67.50 |
| | Non-Medical Department | 27 | 32.50 |
| | Total | 83 | 100.00 |
| Sex/Gender | Men | 43 | 51.80 |
| | Women | 40 | 48.20 |
| | Total | 83 | 100.00 |
| Respondent's Education Level | Under Bachelor's | 12 | 14.50 |
| | Bachelor's | 61 | 73.50 |
| | Master's | 10 | 12.00 |
| | Total | 83 | 100.00 |
| Length of Respondent's Working Experience | < 5 years | 25 | 30.10 |
| | 5 to 10 years | 31 | 37.30 |
| | > 10 years | 27 | 32.60 |
| | Total | 83 | 100.00 |

### Descriptive Statistical Analysis

The descriptive statistical analysis can be observed in Table 3. The total number of data analyzed is 83. On average, the values of the four variables in this study range between 3.84 and 4.17, indicating a moderate to high range.

**Table 3** Descriptive Statistics Result

| Criteria | Software Quality | User Competence | Top Management Support | HIS Quality |
|---|---|---|---|---|
| Min | 3.87 | 2.69 | 3.13 | 2.96 |
| Max | 4.54 | 4.92 | 4.49 | 4.89 |
| Mean | 4.17 | 4.13 | 3.84 | 4.03 |
| SD | 0.27 | 0.79 | 0.59 | 0.72 |

Before discussing the results of hypothesis testing in this study, several steps of analysis were carried out to ensure that the data being tested were reliable. The first step was to test the validity and reliability of the measurement model. These results can be observed in Table 4.

**Table 4** Construct Reliability and Validity Test Result

| | Cronbach's Alpha | Outer Loading | Composite Reliability | Average Variance Extracted (AVE) |
|---|---|---|---|---|
| Software Quality | 0.977 | 0.971 | 0.975 | 0.570 |
| User Competence | 0.841 | 0.962 | 0.841 | 0.535 |
| Top Management Support | 0.933 | 0.981 | 0.929 | 0.504 |
| HIS Quality | 0.944 | 0.966 | 0.956 | 0.784 |

In Table 4, the values for all Cronbach's Alpha testing models were above 0.7. Meanwhile, the value of composite reliability was in the range of 0.6-07, meaning that all constructs had good value and were reliable (Hair et al., 2021).

A hypothesis test was performed in the next stage, with Figure 2 representing the research model result.

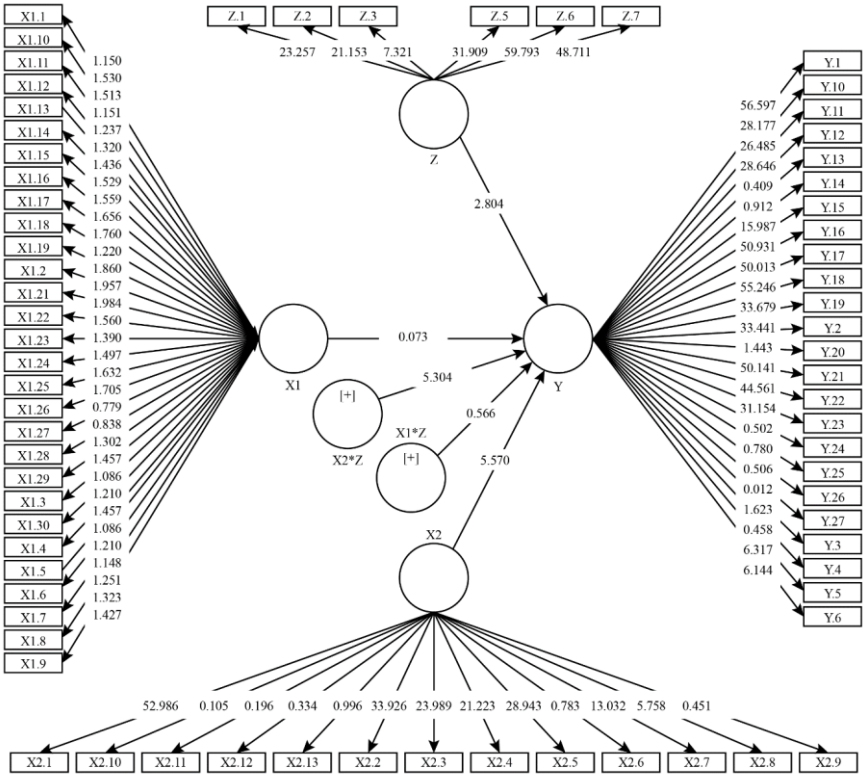


**Figure 2** Research Model Result

**Hypotheses Testing**

Based on Table 5, the results of testing the hypothesis in this study can be seen. It was found that two hypotheses were supported, while two were not supported. For hypothesis testing, Software Quality -> HIS Quality and Software Quality*Top Management Support -> HIS Quality were not supported because they had a value above the significance level of 0.05. Meanwhile, for testing the hypotheses User Competence -> HIS Quality and User Competence*Top Management Support -> HIS Quality, they were supported, as their values were below the predetermined significance level.

**Table 5** Hypotheses Test Result

| | | $\beta$ | SD | T-Statistics | P-Values | Supported? |
|---|---|---|---|---|---|---|
| Software Quality -> HIS Quality | $H_{1\,(+)}$ | -0.007 | 0.097 | 0.077 | 0.939 | No |
| Software Quality*Top Management Support -> HIS Quality | $H_{2\,(+)}$ | 0.078 | 0.128 | 0.613 | 0.540 | No |
| User Competence -> HIS Quality | $H_{3\,(+)}$ | 0.450 | 0.094 | 4.772 | 0.000 | Yes |
| User Competence*Top Management Support -> HIS Quality | $H_{4\,(+)}$ | 0.411 | 0.098 | 4.199 | 0.000 | Yes |

Following that, to find out the magnitude of the influence between variables, the R-Square value was needed to know. Based on the R-square value, software quality, and user competence could explain the variability of the construct of health information system quality by 75.4%, and the remaining 24.6% was explained by other constructs that were not studied. Then, to gauge the extent of the influence of the top management support variable as a moderator variable, the following analysis is presented:

**Table 6** f-Square Value

| | Effect Size |
|---|---|
| Software Quality | 0.000 |
| Software Quality*Top Management Support | 0.015 |
| User Competence | 0.527 |
| User Competence*Top Management Support | 0.525 |
| Top Management Support | 0.203 |

In the Table 6, it was uncovered that top management support did not strengthen the relationship between software quality and HIS quality, as it had a value below 0.02. Meanwhile, top management support could strengthen the relationship between user competence and HIS quality with a considerable influence because it had a value above 0.35 (Hair et al., 2021). On the other hand, based on the results of data analysis, the dependent variable in this study, namely the health information system, was found to exhibit lower values of RMSE and MAE for the Partial Least Squares (PLS) model compared to the Linear Model (LM). This trend was observed across most of the 27 measurement indicator items. This implies that the proposed PLS model demonstrated medium predictive strength and outperformed the LM model in terms of prediction accuracy (Hair et al., 2019).

**Discussions**

**The Effect of Software Quality on HIS Quality**

Based on the hypothesis testing results, it has been proven that the software quality did not have a positive effect on HIS quality. Software quality could not have a positive and significant influence on the quality of the health information system; even from a descriptive analysis, the value of software quality was not too high, meaning that the quality of the existing software is still not of good quality. Based on findings in the field,

users still complained about software errors or network connectivity issues as well. Without the support of software that is agile, reliable, and can process data, quality information is difficult to produce (Tambotoh et al., 2016). Supporting that finding, the research conducted by Khaddaj and Horgan (2004) revealed that in a large information system environment, good software is not enough; it must also have many complete attributes.

**Software Quality Effect on HIS Quality Moderated by Top Management Support**

In this second hypothesis test, top management support did not strengthen the influence of software quality on information system quality. In fact, top management support is important in every organization, and hospitals are no exception. High top management commitment is required to support all hospital operational activities. However, in this study, quality software was not enough to influence the quality of the health information system in Bandung City hospitals. Based on research disclosed by von Hellens (1997), it was found that sometimes, software quality and information system quality have characteristics that are not necessarily related; managerial aspects, organizational aspects, and engineering aspects are factors driving the success of an organization in utilizing information systems.

**The Effect of User Competence on HIS Quality**

In the third hypothesis test, it was exposed that user competence had a positive effect on HIS quality. The results indicate that user competence had a positive and significant influence on the quality of HIS. The competence of information system users is a fundamental component in supporting the success of information systems. Because users of HIS must understand medical matters and have extensive knowledge of the health sector, the competence of users in HIS must be continuously improved (Mulyani, 2016). These results align with research conducted by Maulana (2022) and Murtadho et al. (2018), where the competence of information system users will support the creation of quality information systems. Users are required to have adequate skills, good experience, and an understanding of the technical elements so that a quality information system can be produced (Fitrios et al., 2022).

**User Competence Effect on HIS Quality Moderated by Top Management Support**

Departing from the fourth hypothesis test, top management was known to strengthen the influence of user competence on the quality of information systems. Users or it can also be called Brainware, of course, have characteristics that are very different from software. Software will not be able to operate without the help of its users, while users can easily decide when to use the software. Even though the two seem to complement each other, in fact, user competence has a more meaningful essence than software, which is only "inanimate objects." From that, top management in hospitals must support and encourage human resources and information system users always to develop through various kinds of training (Darma et al., 2018; Murtadho et al., 2018). Support in the form of investment funds will also reinforce the quality of information systems in an organization (Susanto & Bong, 2018).

## Conclusion

This study in Bandung hospitals revealed key factors in the development of HIS. It was discovered that software quality did not directly impact system quality, and top management support also did not strengthen the link between software quality and system quality. The issue lies in poor interoperability among hospital applications, causing discomfort for users who need to navigate multiple systems like SISRUTE and SIRANAP. However, user competence significantly influenced system quality. Related to that, without skilled users, effective HIS are unattainable. Users act as the "Brainware" of the system, requiring adaptability and agility. As such, top management support becomes crucial, especially in providing software, hardware, funding, and understanding user needs. Bandung hospitals should, therefore, integrate their health information applications to simplify user experience and encourage data updates. Automation and reducing duplication

are essential for user comfort and system reliability. Strong commitment from hospital management is necessary for a reliable, credible, and accountable information system.

The study's limitation is the small number of users involved, urging future research to include more users from various hospitals in Bandung. This study also refrained from conducting comprehensive observations of all extant HIS. Consequently, the precise reasons for the non-realization of health information system integration in Bandung City remain unknown despite the pivotal role integration plays in bolstering a high-quality information system. Consequently, there is still an opportunity to undertake research utilizing a qualitative approach to identify factors conducive to the successful implementation of a health information system.

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## Conflicts of interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.