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Determining Key Performance Indicators for the Operational Dashboard of the IT Unit at Educational Hospitals

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ABSTRACT

The growing healthcare data highlights the need for tools like dashboards to convert data into insights and inform decisions. This study aimed to identify the key performance indicators for designing an operational dashboard for the IT unit of Ahvaz Educational Hospitals, with the goal of enhancing transparency and efficiency. This developmental-applied study used a mixed-methods approach (qualitative-quantitative). KPIs were identified and validated through expert panel surveys, utilizing the Content Validity Index and Content Validity Ratio. A minimum dataset of 124 KPIs was finalized across seven domains: general duties, hardware, software, network, HIS, internet, and reporting. The dashboard was developed using a layered architecture (Data-Core-View) and technologies including ASP.NET Core, C#, MVC pattern, and Chart.js. Experts confirmed the relevance, clarity, and necessity of the KPIs. The dashboard enabled real-time IT performance monitoring, analytical reporting, and access control. Technological choices enhanced visualization accuracy and system responsiveness. The dashboard effectively improved IT performance monitoring and decision-making in educational hospitals, despite challenges like data sensitivity, system interoperability, and user resistance. The findings support the use of business intelligence tools in healthcare IT management.

Keywords: Quality Indicators, Health Care, Data Visualization, Health Information Systems, Decision Support Systems,

INTRODUCTION

In the healthcare system, a high volume of data is generated at the point of daily activities—such as patient information, costs, procedures, and outcomes—and is centralized. However, the main question is whether these data are transformed into useful information or merely collected. The absence of integrated cumulative systems for coherent reporting and long-term decision-making by organizational managers has highlighted the need for employing an intelligent analytical tool (1). Dashboards are one of the key tools in business intelligence; they essentially represent a display of a collection of graphical elements (numbers, texts, and images) that, by connecting to databases, provide a concise and unified view of the most important and strategic information (1). Dashboards are categorized based on their intended purpose into three main groups: strategic or managerial, operational or informational, and tactical or analytical (2).

The most common among them are operational dashboards, which focus on monitoring routine organizational performance and providing reports on immediate, real-time activities (2).

Organizations' dependency on information technology is increasing daily. With the systematization of processes and a growing need for information software, it can be considered an important tool for operational efficiency (3-5). The Hospital Information

Technology Unit is one of the support and administrative units tasked with pursuing specialized missions and objectives as directed by the Statistics and Information Technology Office of the Ministry of Health (3-5).

Government pressure to optimize cost management and enhance the quality of care through the utilization of information technology, the improvement of patient electronic record standards, and the safeguarding of patient confidentiality has significantly amplified the importance of information technology management in healthcare centers (5).

Round-the-clock support, including the resolution of hardware and software issues, network setup and maintenance, security evaluation, training, information dissemination, and administrative affairs, constitutes the core functions of the IT unit (5). Furthermore, the management and support of the hospital information system, serving as the primary source of information flow within the hospital, have been delegated to the informatics unit (5).

Numerous studies have demonstrated that the design of hospital dashboards has a significant impact on care performance and the dissemination of medical information (6). The use of the laboratory performance dashboard has significantly contributed to reducing unnecessary tests, managing the number of tests, allocating resources, and planning for this department (7).

The design of this tool has a wide range of applications in various clinical units, particularly in the Emergency Department. The first version of the ED dashboard was successfully launched in 2013, covering the three principles of anytime, anywhere, and at a glance (8). This version underwent three major revisions, and by achieving a usability score of 67.6%, it earned an "OK to GOOD" usability rating (8).

Clinical and cost-related concerns have impacted pharmacy services due to the complexity of their structure and the diversity of drugs (9). Dashboards, using three key performance indicators—managerial, financial, and clinical—can expedite the monitoring of hospital pharmacies (9). Creating a dynamic and semi-real pharmacy dashboard under COVID-19 pandemic conditions can play a significant role in managing the workload of outpatient centers (10).

In general, within the therapeutic realm, the implementation, evaluation, and development of a dashboard—designed to enhance quality care for patients by displaying evidence-based quality indicators in the electronic health record can lead to improvements in patients' diagnostic and therapeutic processes, as well as strategic decision-making by senior managers (11).

The design of dashboards and integrated information systems is also significant in the context of IT governance. One of the most important issues that managers must consider and use as a criterion for their strategic decision-making is the evaluation of the alignment between the organization's business environment and its information technology services (3-5, 12).

In fact, dashboard software, by generating a graphical summary of the data, informs the user about the current status of the organization's business processes (in this context, those pertaining to hospital units) (3-5, 12).

This is achieved through the development, implementation, and monitoring of performance measurement criteria. These performance metrics are defined by global standards such as ITIL and COBIT 5 (13).

Additionally, this tool can be employed in managing computer network security and cyber incidents by querying databases to store and interconnect various network information, such as hosts, services, and the impact of vulnerabilities. The implemented decision support systems then recommend system controls to the user, such as authorizing or restricting access to hosts (14).

In addition to examining the utilization of dashboards across various fields, evaluating their usability is also of great importance. In this context, by employing instruments such as the System Usability Scale (SUS) questionnaire, the Technology Acceptance Model (TAM), the Situation Awareness Rating Technique (SART), the Questionnaire for User Interaction Satisfaction (QUIS), the Unified Theory of Acceptance and Use of Technology (UTAUT), and the Health Information Technology Usability Evaluation Scale (Health-ITUES), the evaluation criteria for the dashboard were determined to include usefulness, efficiency, learnability, ease of use, task suitability, enhancement of situational awareness, satisfaction, user interface, content, and system capabilities (15).

Given that in recent years the use of business intelligence tools—of which dashboards are the most important—has expanded across various sectors of the Ministry of Health, this development should be capable of addressing the diverse shortcomings in the performance of hospital departments (16).

Since the hospital informatics unit supports specialized systems and processes and requires the formulation of broad strategic decisions (at both the hospital management and the overseeing university level), clarifying the daily tasks and functions of this unit is more critical than ever (5).

In this regard, the primary objective of this study was to identify the key performance indicators of the hospital information technology unit, which serves as the basis for creating an operational dashboard for this unit. Additionally, the innovation of the present study lies in creating a transparent functional structure for the tasks in this area, enabling optimal decisions at both tactical and strategic levels to enhance its performance.

METHODS

This study was of a developmental-applied type based on hospital information, conducted during the period of 2023–2024 in the educational hospitals of Ahvaz. The research was designed using a mixed-method approach (qualitative and quantitative) with an integrative perspective. It involved consolidating the opinions of an expert panel and employing the CVI (Content Validity Index) and CVR (Content Validity Ratio) techniques to assess content validity.

The study population consisted of the officials from the informatics units of the educational hospitals in Ahvaz (6 individuals), faculty members from the Health Information Technology and Medical Informatics group (6 individuals), and technical specialists working in the management of statistics and information technology at Ahvaz University

of Medical Sciences (10 individuals). Due to the limited size of the study population and the small number of educational hospitals in Ahvaz, sampling was not conducted.

Data collection and identification of key performance indicators (KPIs) for the hospital's IT unit were conducted using two methods: library research and expert interviews.

In the first phase, relevant studies on the research topic were identified by reviewing reputable databases, including PubMed, Scopus, and ScienceDirect, as well as domestic and international journals. For this purpose, a search strategy was designed based on the main keywords in accordance with the MeSH structure, which included "Clinical Dashboard," "Health Dashboard," "Electronic Dashboard," "Management Information System," "Health Care Sector," and "Health Information Technology."

The inclusion criteria for the study comprised domestic and international articles published between 2014 and 2023, focusing on the application of managerial and clinical dashboards in healthcare organizations. Moreover, duplicate articles and studies that addressed the technical and engineering aspects of designing this tool were excluded from the screening process.

Subsequently, the researcher developed an initial checklist comprising 60 items across seven main domains: general duties, hardware, network, software, the hospital information system (HIS), internet and intranet, and reporting. This checklist was evaluated using a 5-point Likert scale.

To ensure the validity of the research instrument, both face validity and content validity were employed. Initially, the face validity of the researcher-developed checklist was confirmed by a panel of experts, consisting of faculty members from the Health Information Technology and Medical Informatics group (six individuals) and technical specialists working in the management of statistics and information technology at Ahvaz University of Medical Sciences (ten individuals). Subsequently, the content validity of the research tool was approved using the Delphi method, ensuring that the designed instrument adequately covers the research objectives.

At this stage, based on the items validated in the initial checklist, the final (secondary) data collection instrument was developed, comprising 100 items. In fact, it can be stated that the items addressed in the first phase of data collection primarily focused on the administrative and managerial aspects of the IT unit’s activities, whereas in the second phase, the checklist was evaluated from a technical perspective and with precise operational principles.

To evaluate content validity, two measures were employed: the Content Validity Ratio (CVR) and the Content Validity Index (CVI). To determine the CVR, a questionnaire was provided to participants to assess each item in terms of necessity, using a three-point Likert scale: "essential," "useful but not essential," and "not essential" (17). According to Lawshe’s standards for CVR, if the focus group comprises six individuals, the minimum acceptable value for each item should be 0.99 (17).

The CVI technique was based on the evaluation of three criteria—relevance, clarity, and simplicity—of each item by a panel of experts. To determine the level of relevance, four options were provided: (not relevant, needs major revision, relevant but needs revision, completely relevant). Similarly, for clarity, the four options were (not clear, needs major revision, clear but needs revision, completely clear), and for simplicity, the options were

(not simple, needs major revision, simple but needs revision, completely simple). To calculate this coefficient, the number of experts who selected options 3 and 4 (indicating the item was relevant/clear/simple) was divided by the total number of experts. Items with a CVI score lower than 0.7 were eliminated, items with scores between 0.7 and 0.79 required revision, and items with scores above 0.7 were approved.

After the final checklist was approved, the minimum dataset was compiled and established as the basis for the dashboard's content.

The operational dashboard for the hospital IT unit was designed and implemented using a layered architecture and the MVC pattern. For the logical (conceptual) design of the software, both structural and behavioral models were employed—including use case diagrams, sequence diagrams, activity diagrams, class diagrams, and collaboration diagrams—using Rational Rose software. In the back-end design, the programming language C# was used, along with the ASP.NET Core framework. In the front-end, HTML, CSS, and the Chart.js library were utilized. Additionally, for data presentation on the dashboard, column charts, line charts, and tables were incorporated.

The conceptual model was developed using Unified Modeling Language (UML) diagrams, including Structural Models (system components) and Behavioral Models (component interactions). Additionally, key technologies used in the physical design included Backend: ASP.NET Core (C#) with RESTful API services, Frontend: Model-View-Controller (MVC) architecture for dynamic web interfaces, and Data Pipeline: Entity Framework for relational database mapping (SQL Server).

For this study, the necessary permission was obtained from the University's Vice President for Research and Technology under registration number U-02280, and confidentiality standards were maintained. In addition, after obtaining the project's ethical code (IR.AJUMS.REC.1402.409), permission to publish the study results was also secured from the relevant authorities.

RESULTS

The consolidated results from the first phase (Delphi) showed that all items in the domains of general duties, hardware, network, and software were approved. However, some items in the internet and intranet domains (with scores of 68/75%), HIS (with a score of 62/5%), and reporting (with scores of 68/75%-50) required revision and modification. In the second phase, the secondary checklist was evaluated using the CVR and CVI techniques by a second panel of experts. The results of this phase also demonstrated that all items were approved in terms of necessity, relevance, simplicity, and clarity.

After the secondary checklist items were approved, the minimum dataset (standardized key performance indicators) for the hospital IT unit's tasks was compiled. In total, considering the need to differentiate between quantitative and qualitative indicators for the software's data entry form, 124 key performance indicators were identified and categorized into various domains: general duties (8 indicators), hardware (21 indicators), software (22 indicators), network (44 indicators), internet and intranet (2 indicators), HIS (19 indicators), and reporting (8 indicators). These indicators served as the foundation for

the design and implementation of the operational dashboard. The KPIs mentioned above are summarized in Tables 1 and 2.

TABLE I. KEY PERFORMANCE INDICATORS

Key Indicators	***Number of Indicators***	***Functional Domain***
Periodic review of validation metrics Participation in hospital committees/FAVA management IT staff training needs	8	General Duties
Inventory of required hardware Purchase request tracking Repaired systems documentation	21	Hardware
Software request forms Support contract logs Bug-fixing monitoring process	22	Software
Network training hours Network equipment status Recorded security incidents	44	Network
Diagnosis/resolution of connection errors	2	Internet/Intranet
SEPAS document transmission logs HIS version updates User training hours	19	HIS
Daily/weekly/monthly performance reports HIS analytical reports	8	Reporting

TABLE II. SUMMARY OF SOFTWARE FEATURES AND FUNCTIONALITIES

Features	***Core Functionality***	***Key Benefits***
KPIs	Comprehensive monitoring of IT unit performance across all functional domains	*Transparent and quantifiable performance metrics*
Reporting	Automated generation of managerial and operational reports (Excel output)	*Time efficiency and reduced manual errors*
Data Visualization	Interactive display through bar/line charts and data tables	*Enhanced pattern recognition and quick insights*
User Management	Role-based access control (RBAC) with activity-specific permissions	*Improved data security and organizational compliance*
Basic information	Display basic information such as the number of available computer systems or the number of active and inactive users	*Transparency and reliability of recorded data*

DISCUSSION

In this study, the design and implementation of an operational dashboard for the IT unit of Ahvaz Educational Hospitals was carried out with the aim of enhancing oversight, facilitating decision-making, and optimizing managerial processes. Based on the findings, a set of 124 key indicators across seven domains was identified and standardized.

Following validation, these indicators served as the functional foundation of the dashboard. The results align with a similar study by Victor et al. (2021), which highlighted the significance of accurately identifying key performance indicators (KPIs) to enhance the transparency and efficiency of hospital information systems (18).

As mentioned earlier, one of the key achievements of this study was identifying user needs and key performance indicators (KPIs) within the hospital IT department, which was accomplished through surveys conducted with expert panels. This process is similar to previous research, such as that by Rabiei and Almasi (2022) and Kharazmi et al. (2023), which emphasized the importance of accurately identifying user needs and defining key performance indicators (19, 20). In this study, after identifying the indicators, their evaluation and validation demonstrated that they are relevant, simple, and understandable. This outcome underscores the high reliability and precision of the selected indicators for monitoring the performance of the information technology unit. In contrast to the study by Alolayyan et al. (2020), which highlighted challenges related to the lack of integration among performance indicators in hospital systems, the present study addresses this gap by proposing a comprehensive and standardized framework, thereby taking a significant step toward resolving these challenges (21).

The minimum dataset compiled in this study was designed based on the actual needs and various functions of the hospital IT unit. This approach is consistent with similar processes in the studies by Fallahnejad and Safdari (2021) and Kharazmi et al. (2023), where efforts were also made to design performance indicators that best align with the real needs of users and hospital systems (19, 22). This direct alignment with actual needs ensures that the data is effectively used in decision-making, resulting in optimized performance.

The most important aspects of dashboard design in this study include the use of a layered architecture (Data-Core-View) and modern technologies for data analysis. These methods provide easy access to data, real-time reporting, and accurate system status analysis. Similarly, studies by Haghighat Hosseini et al. (2016), Kharazmi et al. (2023), and Rabiei and Almasi (2022) have also emphasized the implementation of integrated architectures and the analytical capabilities of dashboards (19, 20, 23). These features not only enable the evaluation of system performance but also allow managers to review the performance of the IT unit in real time and improve managerial processes.

From a functional perspective, the dashboard's performance evaluation revealed that features such as real-time monitoring, visual data representation through bar/line charts, and predictive trend analysis using drill-down capabilities significantly enhanced data accessibility and analytical processing speed. These findings align with those of Lee et al. (2017), whose study demonstrated that operational dashboards with advanced analytical functionalities can reduce managerial decision-making time by approximately 30% (24). Studies by Safdari et al. (2018) and Rabiei and Almasi (2022) also utilize graphical dashboards to present detailed reports and analytical data through integrated charts and tables (21, 25). Furthermore, high user satisfaction scores regarding the interface usability and accessibility features (including mobile responsiveness and remote access) underscore the system's adaptability and user-centric design.

In the domain of resource management, the designed dashboard enabled optimal allocation of human and financial resources, leading to improved project management

and IT unit budgeting. This finding aligns with Shawahna et al. (2019) results demonstrating that data-driven management tools can enhance resource productivity (26).

Additionally, managing access and establishing different access levels for users was another prominent feature of the dashboard, aligning with the hospital's security requirements and the needs of users handling sensitive data.

This study faced certain limitations that may impact the generalizability of its findings. These included limited access to confidential data, user resistance to adopting technology, subpar data quality, and the necessity for long-term evaluation of the dashboard's effect on IT performance.

Based on the results of this study, improving data standards, ongoing staff training, and allowing dashboard customization can enhance system performance. Expanding its use to other departments may also increase hospital efficiency. Future research should investigate the impact of operational dashboards on reducing hospital costs and optimizing resources, compare dashboard models across hospitals to identify optimal designs, and evaluate their effect on improving healthcare quality and reducing clinical errors.

CONCLUSION

This study demonstrated that designing an operational dashboard for the hospital IT unit can improve access to integrated data, reduce errors arising from delays in data retrieval, accelerate performance analysis, and facilitate managerial decision-making. Findings from user needs assessments, the identification of key performance indicators, and the compilation of a minimum dataset confirmed the dashboard's effectiveness at the IT unit level. The system architecture, designed using modern models, enabled the provision of analytical reports and real-time data displays, allowing managers to allocate resources optimally. Ultimately, this dashboard not only enhanced the monitoring of the IT unit's performance but also improved transparency, coordination, and the quality of managerial decision-making.

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Declaration of the Use of Artificial Intelligence Tools

The authors stated that they did not use any artificial intelligence tools in conducting this study and preparing this article. However, the DeepSeek AI tool was used for the final grammatical review.

Contributorship Statement

MN handled data acquisition, manuscript drafting, and statistical analysis. AA oversaw supervision and provided critical revisions of the manuscript. All authors participated in the conception and design, data analysis, and interpretation, as well as administrative and technical support. Additionally, all authors reviewed and commented on the manuscript, sharing responsibility for its content.

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Declaration Of Conflicting Interests

The authors declared there are no conflicts of interest regarding the research, authorship, and publication of this article.

Data Availability Statements

The authors do not have permission to share data. Given that the data used in the research is related to the hospital's information technology unit, maintaining the confidentiality of the information is a basic condition for its collection.

REFERENCES

1. Dash S, Shakyawar SK, Sharma M, Kaushik S. Big data in healthcare: management, analysis and future prospects. Journal of Big Data. 2019;6(1). DOI: https://doi.org/10.1186/s40537-019-0217-0
2. Rivera D, Shanks G. A Dashboard to Support Management of Business Analytics Capabilities. Journal of Decision Systems. 2015;24. DOI: https://doi.org/10.1080/12460125.2015.994335
3. Nugroho H. Proposed IT Governance at Hospital Based on COBIT 5 Framework. International Journal on Artificial Intelligence Tools. 2017;1:52-8. DOI: https://doi.org/10.25124/ijait.v1i02.875
4. Shahi M, Sadoughi F, Ahmadi M. Information technology governance domains in hospitals: a case study in Iran. Glob J Health Sci. 2014;7(3):200-8. DOI: https://doi.org/10.5539/gjhs.v7n3p200
5. Shahi M, Sadoughi F, Ahmadi M, Davari dolatabadi N. The Current State of IT Governance in Education and Training Centers in Iran University of Medical Sciences: A Qualitative Study. Journal of Health and Biomedical Informatics. 2015;2(2):94-105. (In Persian). http://jhbmi.ir/article-1-94-en.html
6. Rouhani S, Zamenian S, Rotbie S. A prototyping and evaluation of hospital dashboard through end-user computing satisfaction model (EUCS). Journal of Information Technology Management. 2018;10(3):43-60. DOI: https://doi.org/10.22059/jitm.2019.282572.2362
7. Dargahi H, Torabi M, Safdari R, Goodarzi M, Bayat M. Designing dashboard: An innovation for effective management of medical laboratory. Laboratory and Diagnosis. 2018;9(38):44-52. (In Persian). http://labdiagnosis.ir/article-1-261-en.html
8. Yoo J, Jung KY, Kim T, Lee T, Hwang SY, Yoon H, et al. A real-time autonomous dashboard for the emergency department: 5-year case study. JMIR mHealth and uHealth. 2018;6(11):e10666. DOI: https://doi.org/10.2196/10666
9. Dehghani Mahmoodabadi A, langarizadeh M, Mosaddegh Mehrjardi MH, Emadi S. Digital Dashboard for Improving Pharmacy Management: A mixed-method study. Applied Health Information Technology. 2020;1(1):36-45. DOI: https://doi.org/10.18502/ahit.v1i1.5257
10. Al-Jazairi AS, Horanieh BK, Alswailem OA. The usefulness of an ambulatory care pharmacy performance dashboard during the COVID-19 pandemic in a complex tertiary care system. Am J Health Syst Pharm. 2021;78(9):813-7. DOI: https://doi.org/10.1093/ajhp/zxab049
11. Helminski D, Kurlander JE, Renji AD, Sussman JB, Pfeiffer PN, Conte ML, et al. Dashboards in Health Care Settings: Protocol for a Scoping Review. JMIR Res Protoc. 2022;11(3):e34894. DOI: https://doi.org/10.2196/34894
12. piri Z, Raef B, moftian N, dehghani M, khara R. 42: DESIGNING A DASHBOARD FOR EVALUATION THE BUSINESS-IT ALIGNMENT STRATEGIES IN HOSPITALS ORGANIZATIONS. BMJ Open. 2017;7(Suppl 1):bmjopen-2016-015415.42. DOI: https://doi.org/10.1136/bmjopen-2016-015415.42
13. Schaefer J, Baierle I, Nara E, Benitez G, Haetinger C. Corporate governance and information technology: A hybrid vision based on COBIT and ITIL for small companies. XL Encontro Nacional de Engenharia de producao, Foz do Iguaçu, Brazil, October. 2020:20-3. https://www.researchgate.net/publication/344885938
14. Matta L, Husák M, editors. A Dashboard for Cyber Situational Awareness and Decision Support in Network Security Management. 2021 IFIP/IEEE International Symposium on Integrated Network Management (IM); 2021 17-21 May 2021. https://www.researchgate.net/publication/351687899
15. Almasi S, Bahaadinbeigy K, Ahmadi H, Sohrabei S, Rabiei R. Usability Evaluation of Dashboards: A Systematic Literature Review of Tools. Biomed Res Int. 2023;2023:9990933. DOI: https://doi.org/10.1155/2023/9990933

16. Shittu R, Ehidiamen A, Ojo O, Zouo S, Olamijuwon J, Omowole B, Olufemi-Phillips A. The role of business intelligence tools in improving healthcare patient outcomes and operations. World Journal of Advanced Research and Reviews. 2024;24:1039-60.
DOI: https://doi.org/10.30574/wjarr.2024.24.2.3414
17. Sarpourian F, Poursadeghfard M, Erfannia L, Khayami SR, Sharifian R. Identifying and Validating Data Elements and Main Characteristics of a Teleconsultation and Televisit System for Patients with Multiple Sclerosis in Iran. Telemed J E Health. 2024;30(12):2851-8.
DOI: https://doi.org/10.1089/tmj.2024.0103
18. Victor S, Farooq A. Dashboard Visualisation for Healthcare Performance Management: Balanced scorecard method. Asia Pacific Journal of Health Management. 2021;16:28-38.
DOI: https://doi.org/10.24083/apjhm.v16i2.625
19. Kharazmi E, Shirazi AMA, Yazdani A. Development and usability evaluation of a web-based health information technology dashboard of quality and economic indicators. Frontiers in Health Informatics. 2023;12:151.
DOI: https://doi.org/10.30699/fhi.v12i0.466
20. Rabiei R, Almasi S. Requirements and challenges of hospital dashboards: a systematic literature review. BMC Med Inform Decis Mak. 2022;22(1):287.
DOI: https://doi.org/10.1186/s12911-022-02037-8
21. Alolayyan MN, Alyahya MS, Alalawin AH, Shoukat A, Nusairat FT. Health information technology and hospital performance the role of health information quality in teaching hospitals. Heliyon. 2020;6(10):e05040.
DOI: https://doi.org/10.1016/j.heliyon.2020.e05040
22. Fallahnezhad M, Safdari R. Evaluation of the Analytical Dashboard of Designed Health Insurance Deductions, based on Business Intelligence. Journal of Payavard Salamat. 2021;15(3):303-18. (In Persian).
http://payavard.tums.ac.ir/article-1-7010-en.html
23. Hoseini ASH, Dr. HB, Dr. FS, Dr HZ. Extracting the Information Technology architecture of hospitals with approach of Implementing in Iran. Journal of Information and Communication Technology. 2016;8(27):37-46. (in persian).
http://jiu.ir/en/Article/1616/FullText
24. Lee K, Jung SY, Hwang H, Yoo S, Baek HY, Baek RM, Kim S. A novel concept for integrating and delivering health information using a comprehensive digital dashboard: An analysis of healthcare professionals' intention to adopt a new system and the trend of its real usage. Int J Med Inform. 2017;97: 98-108.
DOI: https://doi.org/10.1016/j.ijmedinf.2016.10.001
25. Safdari R, Mirzaee M, Mehdibagli M. Compilation of Patient Safety Dashboard Indicators. Journal of Payavard Salamat. 2018;12(2):150-60. (In Persian).
http://payavard.tums.ac.ir/article-1-6530-en.html
26. Shawahna R. Development of key performance indicators to capture in measuring the impact of pharmacists in caring for patients with epilepsy in primary healthcare: A Delphi consensual study. Epilepsy Behav. 2019;98(Pt A):129-38.
DOI: https://doi.org/10.1016/j.yebeh.2019.07.034