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METHODS OF VISUALIZING ANALYTICAL DATA ON MEDICATION INTAKE

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Анотація

У тезах розглянуто основні методи та інструменти візуалізації аналітичних даних у веборієнтованих системах моніторингу прийому лікарських засобів. Проаналізовано переваги та недоліки різних підходів до відображення медичної інформації: часових рядів, інтерактивних дашбордів, теплових карт та кругових діаграм. Показано, що ефективна візуалізація підвищує прихильність пацієнтів до лікування та якість прийняття клінічних рішень.

Ключові слова: візуалізація даних, лікарські засоби, моніторинг, дашборд, інформаційно-аналітична система, веборієнтована система.

Abstract

The paper examines the main methods and tools for visualizing analytical data in web-oriented medication intake monitoring systems. The advantages and disadvantages of various approaches to displaying medical information are analyzed, including time series, interactive dashboards, heat maps, and pie charts. It is shown that effective visualization improves patient adherence to treatment and the quality of clinical decision-making.

Keywords: data visualization, medications, monitoring, dashboard, information-analytical system, web-oriented system.

Introduction

The rapid development of digital health technologies has led to increasing demand for software systems that enable real-time monitoring of patient medication intake. Medication non-adherence remains one of the most critical challenges in modern healthcare, contributing to treatment failure, disease progression, and increased hospitalization rates [1]. Web-oriented information-analytical systems designed for medication control provide an effective means of addressing this issue. A key component of such systems is the visualization module, which transforms raw medication intake data into comprehensible graphical representations for both patients and healthcare professionals [2].

The relevance of this topic is determined by the growing volume of patient data in digital health platforms and the need for efficient tools to analyze and interpret this data. Proper visualization not only improves user experience but also directly influences the quality of clinical decisions. This paper discusses the principal methods of analytical data visualization applicable to medication monitoring systems, evaluates their effectiveness, and proposes recommendations for their implementation.

Classification of Data Visualization Methods

Visualization methods applicable to medication monitoring systems can be broadly classified into static and dynamic (interactive) categories. Static visualizations, such as bar charts, line graphs, and pie charts, present a fixed snapshot of data and are suitable for summary reports and printed materials. Dynamic visualizations, including interactive dashboards and animated time series, allow users to filter, zoom, and explore data in real time, which is particularly valuable in clinical settings [3].

Time series charts are among the most widely used visualization tools for medication data. They display medication intake events along a temporal axis, enabling identification of missed doses, patterns of non-adherence, and correlations between intake regularity and clinical outcomes. A well-designed time series visualization should clearly distinguish between scheduled and actual intake events, highlight gaps, and support zooming to different time granularities (daily, weekly, monthly) [4].

Dashboard-Based Approaches

Interactive dashboards represent the most comprehensive visualization approach for web-oriented monitoring systems. A medication dashboard typically integrates multiple chart types – adherence rate

indicators, dose history calendars, trend lines, and alert panels – into a unified, role-specific interface. For patients, dashboards emphasize upcoming doses and adherence statistics; for clinicians, they prioritize aggregate adherence trends and clinical parameter correlations [2]. Leading JavaScript libraries such as D3.js, Chart.js, and Apache ECharts provide robust tools for building such dashboards in browser environments.

Calendar heat maps represent another effective method for visualizing medication adherence over time. By mapping daily or weekly adherence status onto a color-coded calendar grid, they enable rapid visual identification of problematic periods. Studies have shown that patients using calendar-based visualizations demonstrate improved self-monitoring behavior [5]. For analytical purposes, heat maps can also be constructed for population-level data, allowing clinicians to identify systemic adherence issues across patient cohorts.

Comparative Analysis and Selection Criteria

The selection of an appropriate visualization method should be guided by several criteria: the target user group (patient vs. clinician), the nature of the data (individual vs. aggregate), the required level of interactivity, and the technical constraints of the deployment environment. Table 1 summarizes the key characteristics of the main visualization methods.

Table 1 – Comparison of Visualization Methods for Medication Data

Method	**Best Use Case**	**Interactivity**	**Complexity**
Time Series Chart	Individual adherence tracking	High	Medium
Calendar Heat Map	Long-term pattern detection	Medium	Low
Bar/Pie Chart	Summary statistics	Low	Low
Interactive Dashboard	Comprehensive monitoring	High	High

As shown in Table 1, interactive dashboards provide the greatest analytical value but require significant development effort. For systems targeting non-technical users, simpler calendar heat maps or time series charts may be preferable. A hybrid approach – offering simplified views for patients and advanced dashboards for clinicians – is considered optimal for comprehensive medication monitoring platforms [3].

Conclusions

Effective visualization of medication intake data is a critical component of modern web-oriented health monitoring systems. The analysis presented demonstrates that time series charts, calendar heat maps, and interactive dashboards are the most suitable methods for representing individual and aggregate adherence data. The choice of visualization method should be driven by user roles, data characteristics, and system requirements.

Future development of the proposed information-analytical system should incorporate adaptive visualizations that adjust to individual user preferences and integrate predictive analytics to proactively identify adherence risks. Implementation of these methods is expected to enhance treatment outcomes and support evidence-based clinical decision-making.

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