# INTEGRATION OF TECHNOLOGY IN CLINICAL DECISION-MAKING: OPPORTUNITIES AND CHALLENGES IN DIGITAL HEALTH SYSTEMS

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## ABSTRACT

**Background**: Digital technologies such as Clinical Decision Support Systems (CDSS), artificial intelligence (AI), and big data are increasingly applied in healthcare to enhance clinical decision-making. While these technologies have the potential to improve care quality and efficiency, challenges in their implementation remain. **Objective**: To explore the opportunities and challenges of integrating digital technologies into clinical decision-making, focusing on the application of AI, CDSS, and big data in hospitals and healthcare facilities. **Methods**: A literature review was conducted using Google Scholar with keywords such as "Health Information Technology" AND "Clinical Decision Making" AND "Implementation Challenges" AND "Opportunities" AND "Hospital." A total of 284 articles were retrieved, with 16 relevant articles analyzed.The focus was on studies published between 2015 and 2025. **Results**: AI, big data, and CDSS offer significant benefits in clinical decision-making, improving diagnostic accuracy, care efficiency, and reducing medical errors. These technologies provide more precise, evidence-based recommendations, enhancing patient safety. However, challenges include limited infrastructure, resistance to change from healthcare professionals, inadequate training, and concerns over data privacy and security. **Discussion :** Findings highlight the importance of training healthcare professionals, improving infrastructure, and addressing regulations and ethics in technology implementation. These factors are key to overcoming challenges and formulating better policies for integrating technology into healthcare. **Conclusion:** Successful implementation requires addressing both technical and non-technical aspects, including healthcare professional training, infrastructure improvement, and a clear understanding of regulations, especially regarding data privacy. This study contributes to the development of strategies for technology integration in healthcare.

Keywords: Health Information Technology, Clinical Decision Making, Implementation Challenges, Opportunities, Hospital.

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## Introduction

The advancement of digital technology, particularly in the healthcare sector, has significantly transformed the process of clinical decision-making. The integration of technological systems such as Clinical Decision Support Systems (CDSS), artificial intelligence (AI), and big data analytics into healthcare systems has brought new hope for improving the quality of healthcare services and patient safety.

CDSS, which utilizes electronic health records (EHR), enables medical professionals to make decisions based on more comprehensive and accurate data. This technology is capable of analyzing vast amounts of patient data from various sources, including electronic medical records, medical imaging, and other relevant information, thereby providing more precise recommendations and minimizing diagnostic errors (Free et al., 2023; Sutton et al., 2020).

However, despite the promising potential of these technologies, significant challenges remain in their implementation. In practice, many healthcare systems struggle to effectively integrate these technologies due to various barriers, including infrastructural limitations, healthcare professionals' lack of proficiency in using new technologies, and the potential overreliance on automated systems, which may compromise the quality of clinical decision-making(Kwan et al., 2020; Zomahoun et al., 2021). Furthermore, issues related to patient data security and the interoperability among existing healthcare systems continue to hinder the optimal implementation of these technologies. Therefore, it is essential to conduct further research on the opportunities and challenges of integrating such technologies, as well as their impact on clinical decision-making.

**Rationale for the Importance of This Research**

This research is essential to explore in greater depth how digital technologies—particularly AI, big data, and Clinical Decision Support Systems (CDSS)—can be effectively integrated into clinical decision-making. Accurate clinical decision-making is directly linked to improved patient quality of life and the overall efficiency of healthcare systems. In this context, technology is expected to contribute to reducing medical errors, enhancing diagnostic accuracy, and streamlining workflows in hospitals or other healthcare facilities. Moreover, in the era of digital health, technology plays a crucial role not only in treatment processes but also in supporting preventive efforts, chronic disease management, and data-driven continuous care (Rahulamathavan et al., 2014; Sanchez et al., 2022).

However, significant challenges persist in the implementation of these technologies. Many healthcare systems are not yet fully prepared to adopt advanced technologies such as AI in clinical decision-making. This is due to limitations in infrastructure, insufficient training of healthcare professionals, and concerns regarding patient data privacy and security. This study aims to identify and analyze the opportunities that can be leveraged and the challenges that must be addressed in implementing these technologies within healthcare systems, both in developed and developing countries.

**Research Objectives**

Specifically, this study aims to:

1. Identify the opportunities that technology can offer to enhance clinical decision-making.
2. Analyze the challenges encountered in the implementation of technology in clinical decision-making.

3. Provide recommendations on the necessary steps to optimize the use of technology in clinical decision-making, particularly within the context of digital health systems.

**Relationship of This Research to Existing Literature, Including Research Gap and Novelty**

This study seeks to deepen existing literature on the integration of technology in clinical decision-making. Most current studies have demonstrated the significant potential of technology in improving the quality of care—for instance, Free et al. (2023) and Sutton et al. (2020) have discussed the success of Clinical Decision Support Systems (CDSS) in reducing medical errors. However, there remains a lack of understanding regarding how these technologies can be effectively integrated into existing healthcare systems across different countries, as well as how healthcare professionals can adopt and utilize them in practice (Kwan et al., 2020). Furthermore, although some studies have addressed the challenges of implementing these technologies, few have systematically examined potential solutions—whether technical, ethical, or practical.

The identified research gap lies in the limited number of studies that link the implementation of technology in clinical decision-making with external factors such as regulation, government policy, and infrastructure readiness. Additionally, while many studies have highlighted the benefits of technology in decision-making, few have explored the original and innovative aspects of AI and big data application in this context—particularly within digital health systems that rely on large-scale data and cross-platform integration.

The novelty of this study lies in its systematic approach to examining the various challenges and opportunities associated with technology adoption, as well as its focus on how these technologies can be applied more practically and adaptively in diverse global contexts.

**Research Problem**

The research problem to be addressed in this study is: *How can the integration of technology in clinical decision-making improve patient care outcomes, and what challenges are encountered in the implementation of digital technology within healthcare systems?*

**Methods**

This study employs a literature review design aimed at exploring and analyzing existing literature related to the integration of technology in clinical decision-making, with a focus on the opportunities and challenges encountered within digital healthcare systems. Additionally, the study will examine the utilization of technology and data in clinical decision-making within the context of hospital settings.

**Search Strategy**

The literature search was conducted using Google Scholar, employing a combination of relevant keywords and Boolean operators to optimize the search and ensure a focused selection of studies aligned with

the research topic. The following keyword combination was used in the search: Keywords: *"Health Information Technology" AND "Clinical Decision Making" AND "Implementation Challenges" AND "opportunities" AND "Hospital"*.

By using this search strategy, the selected literature centers on studies related to the use of technology in clinical decision-making within hospital settings, as well as the associated challenges and opportunities in its implementation.

**Inclusion Criteria**

1. **Research Focus**: Studies that explore or examine the concept of technology in clinical decision-making, highlighting opportunities and challenges in digital healthcare systems or focusing on the utilization of technology and data in clinical decision-making.
2. **Study Type**: Empirical studies (quantitative, qualitative, or mixed-method) providing primary or secondary data on the three concepts.
3. **Full-Text Availability**: Articles available in full-text format.
4. **Publication Source**: Articles published in peer-reviewed journals or reputable academic sources. Theses and dissertations that have been officially published, provided they meet the relevant methodological criteria.
5. **Language**: Studies published in English.
6. **Time Range**: Articles published within the last 10 years (2015–2025).

**Exclusion Criteria**

1. **Irrelevant Research Focus**: Studies that do not focus on the integration of technology in clinical decision-making, opportunities, and challenges within digital healthcare systems.
2. **Non-Academic Publication Types**: Editorials, opinions, commentaries, letters to the editor, or conference abstracts without full-text articles, as well as literature review articles. Non-peer-reviewed publications lacking clear methodological validity.
3. **Language**: Studies published in languages other than English.
4. **Time Range**: Articles published outside the specified time range (more than 10 years ago).
5. **Methodological Limitations**: Studies with non-transparent, invalid, or inadequate methodologies that fail to clearly define and measure the concepts at the focus of the research. Research that does not provide data or analysis that can be critically evaluated in the context of a literature review.

**Research Instrument**

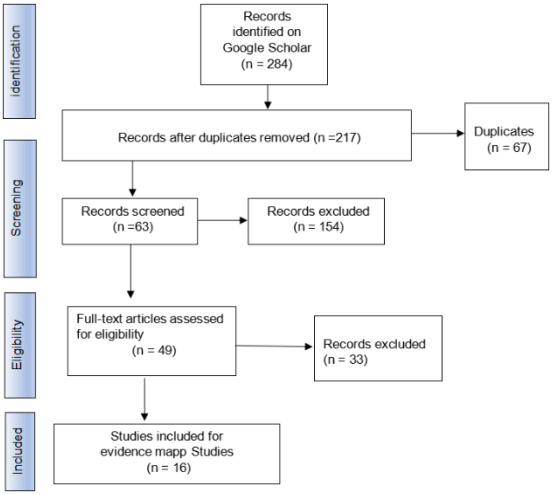
To illustrate the literature selection process in this study, a PRISMA (Preferred Reporting Items for Systematic Reviews

and Meta-Analyses) diagram will be used. The PRISMA diagram will be employed to visualize the study selection process involved in this research, from identification, screening, to the selection of articles that will be analyzed further.

Steps in PRISMA

1. **Identification**: All relevant articles will be identified based on a search using the keywords mentioned above in Google Scholar.
2. **Screening**: After identification, articles that do not meet the inclusion and exclusion criteria will be screened. This screening process includes the removal of duplicates and the selection of articles that are relevant to the topic and have a clear methodology.
3. **Selection**: Articles that meet the inclusion criteria will be selected for further analysis. Only articles that pass this process will be included in the systematic literature review.
4. **Analysis**: The selected articles will be analyzed based on the methodology used, the key findings, and their contributions to the understanding of technology in clinical decision-making.

**Picture 1. PRISMA Flowchart**



**Results**

Table 1. Research Findings

| No | Title | Author and Journal Name | Opportunities | Challenges |
|---|---|---|---|---|
| 1 | Autonomy vs. Artificial Intelligence: Studies on Healthcare Work and Analytics | Doctoral Thesis, Nanyang Technological University, Singapore. (Wang, 2021) | • Application of AI algorithms for diagnosis and clinical decision-making.<br>• Enhancing accuracy in disease prediction such as sepsis. | • Challenges in implementing AI systems still under research.<br>• Resistance to adopting technology by experienced healthcare professionals. |
| 2 | Telemedicine Visits for Patients and Providers at a Rural Clinic Throughout COVID-19: An Evaluation of Experiences and Acceptability in Diabetes Management | Oregon Health and Science University School of Nursing DNP Final Project June 2021.(Eberle & Stichling, 2021) | • Expanding access to healthcare for diabetic patients in rural areas through telemedicine.<br>• Reducing costs and improving care efficiency. | • Limited access to high-speed internet in rural areas.<br>• Challenges in insurance reimbursement for telemedicine services.<br>• Issues with communication and privacy. |
| 3 | Developing Clinical Decision Support Instruments for the Point-of-Care in Low Resource Settings | Thesis, Vrije Universiteit Brussel, 2023.(Tegenaw, 2023) | • Development of CDSS tools to support clinical decision-making in resource-limited areas.<br>• Providing cost-effective and accessible tools with limited infrastructure. | • Lack of infrastructure in resource-limited areas.<br>• Data limitations and readiness of technology to support clinical decision-making.<br>• User acceptance challenges in low-resource settings. |
| 4 | Implementation and use of computerised clinical decision support (CCDS) in emergency | Implementation Science, 2018. (Porter et al., 2018) | • Use of CCDS to support paramedic decision-making in referring elderly patients who have | • Limited technological infrastructure in ambulance services. |

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| | pre-hospital care: a qualitative study of paramedic views and experience using Strong Structuration Theory | | fallen to community-based services.<br>• Enhancing decision accuracy without transporting patients to the hospital. | • Resistance from paramedics preferring to use their clinical judgment.<br>• Technical issues with hardware and software disrupting CCDS usage |
| 5 | Decision support systems for antibiotic prescription in hospitals: a survey with hospital managers on factors for implementation | BMC Medical Informatics and Decision Making, 2024.(Tokgöz et al., 2024) | • Use of AI in decision support systems for antibiotic prescription can reduce antimicrobial resistance.<br>• Improving care quality and reducing hospital costs. | • Lack of knowledge about the system from hospital managers.<br>• Technical infrastructure limitations in hospitals<br>• Challenges in integrating the system into existing workflows. |
| 6 | Lessons Learned from a National Initiative Promoting Publicly Available Standards-Based Clinical Decision Support | Applied Clinical Informatics, 2023.(Dhopeshwarkar et al., 2023) | • Improved access to standards-based and publicly available CDS.<br>• Enhancing efficiency and care quality across hospitals by using standards-based CDS. | • Copyright and licensing barriers on evidence-based guidelines.<br>• Insufficient technological support in hospitals with limited resources.<br>• Limited adoption by EHR developers and technical challenges in implementation. |
| 7 | Factors Influencing the Implementation and Distribution of Clinical Decision | German Medical Data Sciences: Visions and Bridges, 2017. (Kux et al., 2017) | • Implementation of CDSS can enhance care quality by providing evidence-based decision support. | • Main challenges include system quality, integration with EHR, and dependence on technical expertise. |

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| | Support Systems (CDSS) | | • Reducing medical errors through integration of technology into clinical workflows. | • Difficulties integrating systems in hospitals with limited resources.<br>• Regulatory and licensing barriers in Europe |
| 8 | Early Experiences of Integrating an Artificial Intelligence-Based Diagnostic Decision Support System into Radiology Settings | Journal of the American Medical Informatics Association, 2024.(Farić et al., 2024) | • AI can enhance efficiency in detecting and classifying lung nodules.<br>• Boosting clinician confidence in decision-making by providing automatic "second opinions." | • Challenges in integrating AI into existing hospital infrastructure (e.g., PACS).<br>• Limitations in AI performance in certain areas (e.g., near blood vessels).<br>• Procurement costs, maintenance, and data management issues potentially hindering long-term acceptance. |
| 9 | Implementation and Use of a Client-Facing Web-Based Shared Decision-Making System (MyCHOIS-CommonGround ) in Two Specialty Mental Health Clinics | Community Mental Health Journal, 2019. (Finnerty et al., 2019) | • Provides a web-based platform to support shared decision-making between patients and healthcare professionals.<br>• Allows patients with serious mental health issues to be more actively involved in care decisions. | • Funding challenges for staff supporting the use of the application (peer staff).<br>• Differences in system integration into clinic workflows.<br>• Lack of support for insurance-based funding for the application implementation |
| 10 | Physician Satisfaction and Usability of Clinical Decision Support Tools in an Academic Medical Center's | MUSC Theses and Dissertations, 2019. (Gilmartin, 2019) | • Enhancing physician satisfaction with CDS tool designs that better align with their needs and workflows.<br>• Improving CDS adoption by considering usability factors such as | • Low satisfaction with frequent pop-ups and alerts, leading to alert fatigue.<br>• Issues in integrating CDS design into clinical workflows. |

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| | Electronic Patient Record | | layout and system capabilities. | • Resistance to using inefficient or unsuitable CDS tools. |
| 11 | Complex implementation mechanisms in primary care: do physicians' beliefs about the effectiveness of innovation play a mediating role? Applying a realist inquiry and structural equation modeling approach in a formative evaluation study | BMC Primary Care, 2023. (Söling et al., 2023) | • Use of digital technology to improve polypharmacy management and patient safety.<br>• Increasing awareness and knowledge of medication risks in elderly patients. | • Organizational readiness challenges for implementing change.<br>• Physician beliefs about the effectiveness of digital innovations as a barrier.<br>• Obstacles in technology adoption by physicians and uncertainty in daily clinical use. |
| 12 | The Impact of Upgrade towards Comprehensive Electronic Medical Record System on Hospital Performance: A Single Tertiary Care Center Experience in Saudi Arabia | Journal of Business and Management Sciences, 2021. (Alrehaili & Alsharqi, 2021) | • Implementing a comprehensive EMR system can improve clinical effectiveness, patient safety, and production efficiency in hospitals.<br>• Enabling faster and more secure data exchange between healthcare providers. | • Challenges in cost and implementation of new technology.<br>• Barriers in integrating old systems with new ones.<br>• Need for adequate training for medical and technical staff. |
| 13 | Overcoming barriers and enabling artificial intelligence adoption in allied health clinical practice: A qualitative study | Digital Health, 2025.(Hoffman et al., 2024) | • AI potential to improve diagnostic accuracy and efficiency in allied health.<br>• Enhancing service quality by reducing administrative tasks burdening healthcare professionals. | • Lack of AI knowledge among healthcare professionals.<br>• Concerns about job displacement and role replacement by AI.<br>• Lack of organizational and regulatory support for AI implementation. |

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| 14 | Development of a Framework and Checklist to Guide the Translation of AI Systems for Clinical Care | hesis, University of Illinois Chicago, 2024. (Owoyemi, 2024) | • Developing a framework to support the development and implementation of AI in clinics.<br>• Bridging the gap between technology development and real-world application. | • Challenges in integrating AI into existing clinical workflows.<br>• Data and privacy issues.<br>• Lack of technology adoption by healthcare professionals. |
| 15 | Digital Twins for Cyber-Physical Healthcare Systems: Architecture, Requirements, Systematic Analysis, and Future Prospects | IEEE Access, 2025. (Roopa & Venugopal, 2025). | • Digital Twins (DT) offer more personalized and targeted care by creating digital replicas of patient health conditions.<br>• Potential for treatment simulation and disease prediction based on patient data. | • Challenges in integrating physical and digital systems still under development.<br>• Issues related to patient data privacy and the need for secure big data management. |
| 16 | Examining Venous Thromboembolism Post-Operative Orthopedic Care Using Electronic Order Sets | Walden University, 2017. (Remancus, 2017) | • Standardizing the use of VTE order sets based on electronic systems to improve effectiveness and accuracy in post-operative treatment.<br>• Enhancing medical adoption of technology to improve patient care quality post-surgery. | • Dependence on full system adoption by healthcare providers not yet required to use CPOE.<br>• Issues transitioning from paper-based to electronic orders, requiring time and training.<br>• Lack of effective warning mechanisms in the system to ensure proper VTE prophylaxis administration. |

In this study, 16 relevant articles were analyzed to identify the opportunities and challenges in the implementation of technology in clinical decision-making within digital healthcare systems. Each article focuses on various aspects of

technology use, such as Clinical Decision Support Systems (CDSS), artificial intelligence (AI), and other digital technologies, applied in the context of hospitals or healthcare services.

## Discussion

### Relationship with Previous Literature

This study explores the opportunities and challenges in the implementation of technology in clinical decision-making within digital healthcare systems, and its findings are closely aligned with existing literature. Several previous studies, such as those by Free et al. (2023) and Sutton et al. (2020), have shown that the use of Clinical Decision Support Systems (CDSS) can reduce medical errors and improve the quality of care. In this study, we also found that the application of technology in clinical decision-making holds great potential to enhance the accuracy and efficiency of treatment. However, as mentioned by Kwan et al. (2020) and Zomahoun et al. (2021), a major challenge that remains is the reliance on inadequate infrastructure and barriers to acceptance by experienced healthcare professionals.

The findings of this study reaffirm that while technologies such as AI, big data, and CDSS offer significant benefits in enhancing clinical decision-making, factors such as resistance to change, lack of training, and issues with integration into existing healthcare systems continue to be substantial barriers. These findings are consistent with previous research highlighting the difficulties faced by healthcare professionals in integrating new technologies into their clinical practices (Kux et al., 2017). Furthermore, the challenges related to data privacy concerns and reliance on technology in clinical decision-making, as shown in this study, underscore the importance of considering ethical and regulatory aspects in the implementation of technology within the healthcare sector (Porter et al., 2018; Shahmoradi et al., 2021).

### Significance of the Research Findings

The findings of this study provide deeper insights into how technology can be leveraged to improve clinical decision-making in the healthcare sector. These findings are significant as they can inform better policies and practices for integrating technology into existing healthcare systems. With Clinical Decision Support Systems (CDSS) powered by AI and big data, hospitals and clinics can make more accurate, evidence-based decisions, ultimately reducing medical errors and improving patient care quality. Furthermore, this study highlights that in order to maximize the benefits of technology, hospitals and healthcare providers must focus on medical staff training, improving infrastructure, and addressing challenges related to data security and patient privacy.

These findings also indicate that while technology has great potential to transform clinical decision-making processes, its success heavily depends on the readiness of the healthcare system, the training of medical professionals, and the acceptance of technology by practitioners in the field. Therefore, further efforts are needed to support the wider adoption of this technology, including training for

healthcare staff and support from policymakers to address emerging regulatory and ethical issues.

**Contribution of This Research to the Field of Knowledge**

This research makes a significant contribution to the field, particularly in understanding how technology can be effectively integrated into clinical decision-making. The findings of this study enhance our understanding of the challenges in implementing technology within healthcare systems and provide insights into the steps that need to be taken to overcome these challenges. By exploring the existing literature and connecting it with the latest findings, this study offers a more comprehensive view of the use of technology in clinical decision-making.

Additionally, this research provides an important contribution in understanding the gaps in previous studies, particularly related to aspects such as regulation, training, and the acceptance of technology by healthcare professionals. These findings can be used by researchers and practitioners to design more effective policies and strategies for integrating technology in the healthcare sector, as well as providing guidance for future research.

**Implications of the Research**

This research provides important insights for hospitals, clinics, and other healthcare providers on how they can integrate technology into the clinical decision-making process to improve care quality. Furthermore, the findings of this study can also guide policymakers in designing policies that support the adoption of technology within healthcare systems, including medical staff training and infrastructure improvements.

More specifically, the results of this research can be used by technology developers to design more user-friendly systems that can be more easily integrated into existing clinical workflows. This may also lead to the further development of policies that can strengthen patient data protection and reduce reliance on technology in clinical decision-making, while still emphasizing the importance of human judgment in medical contexts.

**Limitations of the Research**

Although this research provides valuable insights, there are several limitations that need to be considered. One main limitation is that this study focuses only on literature published within a specific time frame (2015-2025), meaning that recent developments may not have been covered in this analysis. Additionally, while this study includes various types of studies, there is a limitation in the diversity of study designs used, which may not fully represent the entire spectrum of research in this field.

Another limitation is that this study primarily focuses on literature analysis and does not involve primary data that could provide deeper insights into the experiences of medical practitioners in integrating technology. Therefore, further research involving interviews or surveys with medical practitioners and other stakeholders is needed to gain a more comprehensive perspective on the challenges and opportunities in

implementing technology in clinical decision-making**.**

## Conclusion

This research explores the opportunities and challenges in the implementation of technology in clinical decision-making, particularly in digital health systems. The main findings of this study indicate that technologies such as Clinical Decision Support Systems (CDSS), Artificial Intelligence (AI), and big data can significantly improve decision-making accuracy, care efficiency, and reduce medical errors. The use of these technologies can also enhance the quality of care by providing more accurate, evidence-based recommendations to healthcare professionals. However, this study also reveals various challenges, such as inadequate infrastructure in some hospitals, resistance to technology adoption by more experienced healthcare professionals, and issues related to patient data security and privacy.

Additionally, while technology can provide significant benefits, its success largely depends on the healthcare system's ability to effectively integrate these technologies. The key challenges identified in this research include reliance on insufficient infrastructure, lack of medical staff training, and regulatory and ethical issues related to data privacy. This suggests that, although technology has the potential to transform clinical decision-making, its success requires a holistic approach encompassing technical, human, and regulatory aspects.

## Suggestions for Future Research

1. Further research on the impact of social and cultural factors on technology adoption: To ensure broader technology adoption in the healthcare sector, future research should examine how social, cultural, and behavioral factors among healthcare professionals influence the acceptance of technology in clinical decision-making.
2. Longitudinal studies on technology implementation: More in-depth research is needed to understand the long-term effects of technology use in clinical decision-making, particularly regarding its impact on care quality and patient safety over time.
3. Increased study on regulatory and policy aspects: Related to privacy and data security issues, further research on regulations and policies that support the safe and ethical implementation of health technologies is necessary, especially in different global contexts.

Research on medical staff education and training: To address the challenges related to medical staff training, it is crucial to conduct further research on effective training methods for healthcare professionals to optimize the use of technology in clinical decision-making.

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