



Packaging Design Influence on Diagnostic Kit Identification Efficiency among Laboratory Users

Putri Merak Jingga Sameto¹

¹Universitas Teknologi Digital, Indonesia

 sjingasameto@gmail.com *

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Abstract

Packaging design in diagnostic kits serves a dual function: safeguarding biologically sensitive components and facilitating rapid, accurate communication of technical information to laboratory personnel. This study investigates how visual elements specifically color schemes, typography, layout, and graphic symbols affect the ease of product identification among laboratory users. Using the Numatics PathoScan hrHPV molecular diagnostic kit as a case study, the research adopts a qualitative descriptive approach through visual observation and formal product analysis. Findings reveal that consistent use of color coding enhances differentiation between kit components, while clear typographic hierarchy improves readability under time-sensitive laboratory conditions. Structured layout and standardized graphic symbols further support intuitive recognition, reducing the likelihood of misidentification. The study underscores the importance of packaging as a communication tool that extends beyond aesthetics, directly influencing laboratory workflow efficiency and diagnostic accuracy. Implications highlight the need for integrating principles of visual communication into biomedical product design, ensuring that packaging contributes to both functional safety and user-centered usability. This research provides insights for manufacturers, designers, and laboratory practitioners seeking to optimize diagnostic kit packaging for improved operational outcomes.

INTRODUCTION

Packaging is a fundamental component of visual communication, serving not only as physical protection for a product but also as a medium for conveying product information and brand identity to users. Rust (2020) define packaging as a marketing tool that communicates both brand identity and product functionality to consumers. Over time, the role of packaging has evolved beyond aesthetics and marketing to encompass usability, safety, and effective information delivery, particularly for products requiring a high level of accuracy and reliability. This need is especially evident in in vitro diagnostic (IVD) products and molecular diagnostic kits, which play a critical role in supporting clinical decision-making.

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Unlike conventional consumer products, molecular diagnostic kits must communicate complex technical information in a manner that is clear, concise, and immediately understandable. Essential information including the diagnostic target, number of tests per kit, storage conditions, expiration date, and regulatory status must be presented in a way that enables laboratory professionals to interpret it efficiently while working in time-sensitive environments. Misidentification of a product or incorrect interpretation of packaging information may result in procedural errors, compromise the validity of diagnostic results, and ultimately affect patient safety.

Therefore, packaging for diagnostic products should not be viewed merely as an aesthetic or promotional element (Yuan et al., 2023). Instead, it should be regarded as an integral component of the laboratory communication system, ensuring that critical information is delivered accurately and efficiently to support safe and effective diagnostic procedures. As molecular diagnostics continue to advance and the demand for precision healthcare increases, the need for packaging that is informative, intuitive, user-friendly, and designed with end users in mind has become increasingly important (Ardodi & Martinus Pasaribu, 2024; Wahyudi et al., 2022).

Despite this growing importance, existing research on packaging design has predominantly focused on consumer behavior, purchasing decisions, and marketing strategies. Relatively few studies have examined the role of visual communication in the packaging of molecular diagnostic products, particularly regarding its contribution to product identification by laboratory professionals. This indicates a research gap concerning how visual packaging elements influence product recognition and usability within clinical laboratory environments.

Intan et al (2025), an Indonesian precision molecular diagnostics company, offers a reproductive health product line that includes PathoScan hrHPV, a molecular diagnostic kit designed to detect high-risk Human Papillomavirus (hrHPV) using cervical swab or urine specimens. This product was selected as the case study because it represents a common challenge in diagnostic packaging design: communicating complex clinical information clearly while enabling users to distinguish it from closely related products within the same product family, such as PathoScan hrHPV Lite.

Based on this context, this study seeks to answer the following research question: How do the visual design elements of molecular diagnostic kit packaging facilitate product identification by laboratory users? Specifically, the study aims to examine how visual packaging elements including color, typography, layout, and graphic symbols communicate product information and influence the ease with which laboratory professionals identify diagnostic products.

Existing studies on packaging design primarily examine visual elements from marketing and consumer behavior perspectives, emphasizing brand perception and purchase intention (Enceng et al., 2024; Sekarlaranti & Junaedi, 2016). In contrast, limited attention has been given to the role of visual communication in molecular diagnostic packaging, where packaging serves a safety-critical function by supporting accurate product identification and reducing the risk of operational errors in laboratory settings.

This study contributes to the literature by investigating packaging design from the perspective of laboratory users rather than consumers. Using the PathoScan hrHPV molecular diagnostic kit as a case study, it integrates visual communication theory with the practical requirements of laboratory

workflows, highlighting packaging as a functional communication system that supports usability and diagnostic safety.

Implications. The findings are expected to enrich the theoretical understanding of visual communication and packaging design within the healthcare and medical device sectors. Practically, the study provides recommendations for diagnostic manufacturers and packaging designers in developing user-centered packaging that improves product recognition, minimizes identification errors, enhances laboratory efficiency, and ultimately contributes to safer and more reliable diagnostic services.

METHODS

This study employed a qualitative research approach using a case study design to obtain an in-depth understanding of the role of visual elements in molecular diagnostic kit packaging in facilitating product identification by laboratory users. A qualitative case study was selected because the research does not aim to examine causal relationships or test statistical hypotheses; instead, it seeks to describe and interpret the functions of visual design elements within the context of product use in laboratory settings (Brennen, 2021; Engkizar et al., 2026).

The object of this study was the PathoScan hrHPV molecular diagnostic kit packaging developed by Nusantics. This product was selected as the case study because it represents a diagnostic product containing complex technical information, requiring packaging that communicates essential information clearly, efficiently, and accurately to professional laboratory users. The study utilized both primary and secondary data sources. Primary data were obtained through direct observation of the PathoScan hrHPV packaging by examining its visual design elements, including color, typography, layout, iconography, graphic symbols, and information hierarchy. Secondary data were collected from official Nusantics documentation, including product descriptions, technical specifications, clinical performance information, and other relevant product-related documents.

The research instrument consisted of an observation checklist developed based on the principles of visual communication design. The checklist covered key design aspects, including color, typography, layout, iconography, visual identity consistency, and clarity of information presentation (Engkizar et al., 2025; Engkizar et al., 2026; Mahmudi & Aimah, 2026; Thalib, 2022). This instrument was used to systematically evaluate how each visual element contributes to facilitating product identification by laboratory professionals.

RESULT AND DISCUSSION

The findings indicate that the PathoScan hrHPV packaging effectively fulfills its role as a visual communication medium by conveying both brand identity and essential product information. The prominent placement of the Nusantics logo, the product name on the front panel, and the consistent color scheme across the reproductive health product line enable users to recognize the product and its diagnostic category quickly. These findings support Rust (2020), who argue that packaging functions as a marketing communication tool by communicating product identity and functionality. Likewise, the findings reinforce Susilawati et al (2023) concept of packaging as a *silent salesman*, in which packaging communicates product information independently without relying on sales personnel.

The study further demonstrates that visual elements including color,

typography, layout, and graphic composition play an important role in shaping users' perception and recognition of a product. Previous studies have shown that these visual elements influence consumer perception and product evaluation (Pramesti et al., 2024; Sekarlaranti & Junaedi, 2016). However, the present study extends this perspective by examining packaging within the context of molecular diagnostic products rather than consumer goods. Unlike commercial products, where packaging primarily aims to attract consumers and encourage purchasing decisions, diagnostic product packaging must support accurate product identification, reduce the likelihood of user error, and facilitate efficient laboratory workflows. Consequently, packaging for medical devices incorporates an additional dimension of safety communication, which remains relatively underexplored in conventional packaging design research.



Fig 1. PathoScan hrHPV

PathoScan hrHPV is a real-time qPCR diagnostic kit developed to detect 14 high-risk Human Papillomavirus (hrHPV) genotypes, including HPV16, HPV18, and HPV52, using cervical swab or urine specimens. As an in vitro diagnostic (IVD) product intended for professional laboratory use, its packaging is designed not only to protect the product but also to communicate essential information efficiently and accurately.

The front panel of the packaging presents the **Nusantics** brand identity, the product name (*PathoScan hrHPV qPCR Kit*), the IVD label, and the number of tests contained in each kit. According to Putro et al (2020), these elements serve as the primary visual hierarchy that enables users to recognize the product quickly without reading extensive technical information. The prominent placement of the product name and test target facilitates immediate identification of the diagnostic purpose, which aligns with Kotler and Keller's (2016) view that packaging functions as an effective communication medium for conveying product identity and functionality.

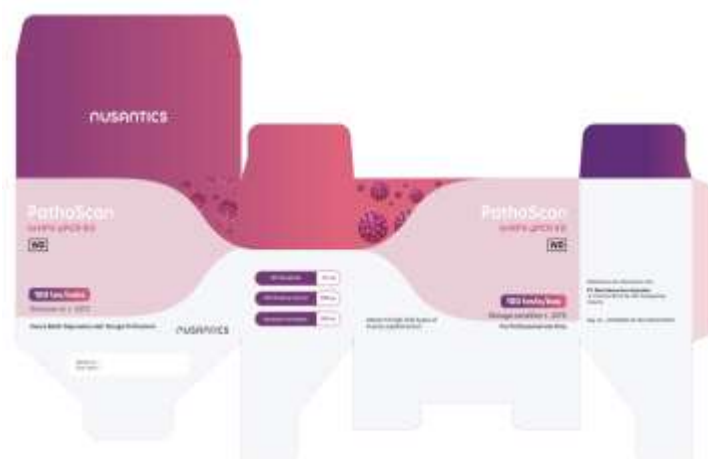


Fig 2. PathoScan hrHPV

In addition to branding elements, the side panel provides concise information regarding the kit components, including the HPV ReadyMix, HPV Positive Control, and Nuclease-free Water, together with their respective volumes. Presenting this information directly on the external packaging enables users to verify the kit contents before opening the box, thereby improving workflow efficiency and reducing the possibility of handling errors during laboratory preparation (Brotherton et al., 2026; Prudden et al., 2022).

Overall, the visual design of the PathoScan hrHPV packaging successfully communicates the product's identity, diagnostic category, and essential technical information. The clear hierarchy of visual elements enables rapid recognition while maintaining consistency with the company's branding strategy. These findings suggest that the packaging fulfills its role as an effective visual communication medium for diagnostic products, supporting both brand recognition and functional usability in clinical laboratory settings (Branda et al., 2024; Intan et al., 2025).

CONCLUSION

This study demonstrates that visual packaging design plays a critical role in supporting product identification for laboratory professionals, extending its function beyond product protection and brand communication. Through the case study of the PathoScan hrHPV diagnostic kit, the findings show that visual elements such as typography, color, layout, and information hierarchy contribute to the rapid recognition of product identity and diagnostic category. However, the study also reveals that effective packaging for molecular diagnostic products requires clear visual differentiation between product variants to minimize the risk of misidentification and support safe laboratory practice. These findings address the research objective by confirming that packaging serves as an essential communication tool that enhances both usability and operational accuracy in clinical laboratory settings.

From a practical perspective, the findings provide guidance for diagnostic manufacturers and packaging designers in developing user-centered packaging that balances brand consistency with clear product differentiation. Incorporating more distinctive visual cues, such as stronger color differentiation, more prominent variant labeling, or additional graphic identifiers, may improve product recognition without compromising the overall brand identity. From a theoretical perspective, this study expands the application of visual communication and packaging design theories by introducing the role of packaging as a safety-oriented communication medium in healthcare products. Future research is recommended to evaluate packaging effectiveness through usability testing with laboratory professionals or experimental studies comparing alternative packaging designs, thereby providing broader evidence for the development of packaging standards for in vitro diagnostic products.

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