



QR Code as a Means of Creating the Rational Pharmaceutical Packaging of the Future

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ABSTRACT:

Pharmaceutical packaging fulfils protective, informational, ergonomic, marketing, and environmental functions; however, the paper leaflet has long ceased to meet the requirements of contemporary digital society, generating considerable environmental and economic costs at scale. Under Federal Law No. 61-FZ "On the Circulation of Medicinal Products," product information must be communicated to the consumer in an accessible and comprehensible form — a requirement that a digital format can fulfil far more effectively. This work proposes a concept of rational packaging comprising the replacement of the paper leaflet with an electronic version accessible via a QR code placed on the box or blister, together with the use of the biodegradable polymer PLA (polylactic acid) as the blister material. A survey of 153 respondents revealed that 72% do not read leaflets in full, 68% are willing to use a QR code, and 65% support a complete transition to electronic format. A comparative economic calculation of three packaging prototypes identified a saving of RUB 10.6 per unit when transitioning to digital format without changing the blister material, equivalent to more than RUB 1,060,000 and approximately 290,000 sheets of paper saved per batch of 100,000 units. Comparison with international research confirms the universal nature of the identified problems and the validity of the proposed solutions, which comply with GOST 17768-90, Federal Law No. 61-FZ, the State Pharmacopoeia of the Russian Federation (14th edition), and align with European Medicines Agency and FDA documents on electronic patient information.

INTRODUCTION

The pharmaceutical industry holds one of the leading positions in the modern economy owing to its direct connection with quality and length of life. Thousands of new medicines

enter the market every year; however, the patient information system evolves considerably more slowly than production technologies. The paper package leaflet, mandatory for every pack under the legislation of most countries, today represents an archaic



element of the pharmaceutical supply chain.

Research conducted in the United States shows that patients with low health literacy correctly interpret, on average, fewer than half of the warning labels on pharmaceutical packaging (Wolf et al. 2006). A similar problem has been identified with respect to package leaflets: the standard leaflet format is successfully understood by only approximately half of patients, whereas a simplified version raises this figure to 71% (Davis et al. 2006). This indicates a systemic mismatch between the traditional format and the actual needs of patients.

In an era of widespread smartphone use, QR codes have become a universal tool for accessing data. The study by Singh, Brand, and Steenkamp (2025), conducted in a real hospital pharmacy setting, showed that more than 80% of patients, regardless of age or sex, are willing to scan a QR code to access an electronic package leaflet, and more than 96% found the electronic format convenient to read. Meanwhile, global demand for environmental sustainability is growing: the production of biodegradable PLA from renewable raw materials reduces CO₂ emissions by 55–75% compared with conventional petrochemical polymers (Ghomi et al. 2021), making the transition to biomaterials an operational necessity.

The present study proposes an integrative concept of rational packaging that combines the digitalisation of the package leaflet via QR code with a partial transition to PLA, and evaluates this concept from economic, social, and environmental perspectives.

RESULTS

A comparative analysis of three packaging models revealed significant differences in both economic and environmental indicators. The sociological survey confirmed high consumer readiness for a digital transition.

The survey (total: 153 respondents) showed that the majority of those surveyed do not use the paper leaflet as their primary source of information about a medicine and demonstrate openness to a digital alternative (see Table 1).

The data obtained are consistent with international research by Wolf et al. (2006), who found that patients correctly interpret fewer than half of warning labels on packaging, and Davis et al. (2006), who showed that simplifying the leaflet format increases comprehension from 50% to 71%. Singh, Brand, and Steenkamp (2025), in a mixed-methods study in a hospital pharmacy, found that more than 80% of patients are willing to switch to an electronic package leaflet via QR code — a result very close to the 68% obtained in the present survey.



Economic comparison. The cost calculation for the three packaging models is presented in Table 2. The transition from Model 1 to Model 2 yields a saving of RUB 10.6 per unit. For a batch of 100,000 packs, the cumulative saving exceeds RUB 1,060,000 whilst simultaneously reducing paper consumption by approximately 290,000 sheets. Model 3 (QR + PLA) costs RUB 14.4 more than the standard owing to the higher cost of the biopolymer blister; however, the bioplastics market is showing stable and sustained growth in output and declining unit costs (European Bioplastics Association 2023), which creates conditions for a gradual convergence of prices with polypropylene over the long term.

Environmental assessment. Eliminating the paper leaflet (Models 2 and 3) reduces pharmaceutical packaging waste by mass by 12–18% per unit. The use of a PLA blister (Model 3) reduces CO₂ emissions during blister production by approximately 55–75% compared with polypropylene (Ghomi et al. 2021). An additional advantage of the digital format is the ability to update package leaflet information in real time without physically replacing the insert, which entirely eliminates the waste generated by changes to a medicine's composition or indications.

DISCUSSION

The results obtained demonstrate that the concept of rational packaging is economically justified, technologically feasible, and socially in demand. The high proportion of respondents willing to use a QR code (68%) is consistent with the data of Singh, Brand, and Steenkamp (2025), who showed similar patient readiness in a hospital pharmacy setting, indicating a general digital readiness among consumers regardless of country of residence. At the same time, the key limitations of the proposed concept must be identified.

First, a portion of the population — particularly elderly people and rural residents — lacks access to a smartphone or a stable internet connection. For this group, a hybrid scenario must be provided: alternative access via pharmacy, telephone helpline, or printed version on request. This is precisely the approach recommended by the European Medicines Agency (2021) in its electronic patient information concept. Federal Law No. 61-FZ does not prohibit the use of electronic means of transmitting information, provided its completeness and accuracy are maintained, which opens a legal pathway for the introduction of digital package leaflets in Russia.

Second, the security and stability of QR links presents a regulatory challenge: manufacturers are obliged to guarantee



continuous access to the current package leaflet throughout the entire period of the medicine's circulation. The American DailyMed experience — the FDA's official database of electronic package leaflets (Food and Drug Administration 2023) — could serve as a model for creating a comparable Russian registry. Third, the transition to PLA is economically unviable for mass production in the short term. However, the use of biopolymers in niche segments (rare diseases, environmentally oriented brands) already creates a precedent and stimulates the development of industrial composting infrastructure. Ghomi et al. (2021), in a comprehensive life-cycle analysis of PLA, demonstrated that this material, when properly disposed of, does not produce toxic degradation products, which is critically important for pharmaceutical applications.

It is important to acknowledge that technological innovations in packaging do not in themselves resolve the problem of low health literacy. The digital format creates opportunities — enlarged text, audio playback, translation into other languages, multimedia video instructions — but their realisation depends on the level of digital literacy among patients, pointing to the need for parallel development of public education programmes.

The proposed concept fits within the international sustainable healthcare

development agenda, actively promoted in the United States, Europe, and Asia. For the Russian pharmaceutical market, the transition to digital package leaflets additionally means reduced dependence on imported coated paper and imported inks for printing inserts.

MATERIALS AND METHODS

The work is based on three methods: literature and regulatory document analysis, a consumer survey, and a comparative calculation of packaging models.

For the theoretical framework, Russian regulatory documents (GOST 17768-90, Federal Law No. 61-FZ, State Pharmacopoeia XIV) and international standards (FDA 21 CFR Part 211, EMA ePI 2021, ISO 14044:2006) were studied, along with specialist articles from PubMed and Scopus.

The survey was conducted in January 2026 in Saransk. One hundred and fifty-three individuals of varying ages answered three closed questions concerning whether they read leaflets and whether they would be willing to switch to QR format. The questionnaire was anonymous, and the data were processed using descriptive statistics methods.

The economic calculation compared three packaging variants: the standard with a paper leaflet, QR code with polypropylene blister, and QR code with PLA blister. Component prices were obtained from Russian suppliers



in 2025; logistics costs were recalculated to account for the reduction in packaging weight.

The environmental assessment was carried out using LCA methodology (ISO 14044:2006), based on published data on PLA production (Ghomi et al. 2021; Auras, Harte, and Selke 2004).

CONCLUSION

The concept of rational pharmaceutical packaging — based on replacing the paper leaflet with an electronic version accessible via QR code and using a biodegradable PLA blister — demonstrates economic viability, technological feasibility, and social demand. The research hypothesis is confirmed: digitalisation of the package leaflet reduces packaging costs by RUB 10.6 per unit (approximately 29%) and saves 290,000 sheets of paper for every 100,000 units produced.

The sociological survey showed that 68% of consumers are willing to use QR codes and 65% support a complete transition away from paper format. Comparison with American and international data indicates the universal nature of the identified problems and the applicability of the proposed solutions in a broad context. The proposed model complies with Russian legislation and is consistent with current EMA and FDA concept documents.

Future research directions include development of a prototype electronic platform for storing and updating package leaflets; a pilot implementation in collaboration with a pharmaceutical enterprise; removal of digital access barriers for elderly patients; and comparative analysis of regulatory requirements across EAEU member states. This work may serve as a foundation for more far-reaching changes in pharmaceutical packaging both in Russia and in international markets.

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TABLES WITH TITLES/CAPTIONS

Table 1. Results of Consumer Survey on Pharmaceutical Products (n = 153)

Question	Yes (%)	No (%)
Do you read paper leaflets in full?	28%	72%
Would you be willing to access the leaflet via a QR code?	68%	32%
Do you support a complete transition to electronic format?	65%	35%

Abbreviations: n = number of respondents.

Table 2. Comparison of Unit Cost for Three Packaging Models (per unit, RUB)

Component	Model 1 (standard)	Model 2 (QR + PP)	Model 3 (QR + PLA)	Change (1→2)
Box printing (RUB)	3.0	1.4	1.4	−1.6
Cardboard box (RUB)	5.0	5.0	5.0	0
Leaflet (RUB)	6.0	0	0	−6.0
Blister (RUB)	10.0	10.0	35.0	0
Logistics (RUB)	12.0	9.0	9.0	−3.0
Total (RUB)	36.0	25.4	50.4	−10.6

Abbreviations: RUB = Russian rouble; PP = polypropylene; PLA = polylactic acid (biodegradable polymer); QR = quick response code. Cost data sourced from Russian suppliers (2025). Logistics recalculated based on reduced packaging weight.