ФАРМАЦІЯ

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SOFTWARE-BASED VERIFICATION OF THE EAN-13 BARCODE CHECK DIGIT IN THE ASSORTMENT OF PHARMACEUTICAL PRODUCTS

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EAN-13 is a widely recognized linear barcode standard used for the identification and labeling of products, including items from the assortment of pharmaceutical products. Verifying the correctness of the barcode's check digit is essential to ensure the accuracy of automated inventory management and stock control. At the same time, products from the assortment of pharmaceutical products that are not subject to mandatory state verification (such as dietary supplements, medical devices) remain vulnerable to labeling and data entry errors.

The aim of our work was to develop a program for verifying the check digit of the EAN-13 barcode as a tool for basic incoming inspection of the labeling accuracy of products that are not subject to mandatory verification but are widely represented on the pharmaceutical market.

The article presents the development of a program for verifying the check digit of the EAN-13 barcode, implemented as a web application based on HTML and JavaScript. The program allows users to enter a 13-digit code, calculate the expected check digit according to the official algorithm, and promptly inform the user of the barcode's correctness. The developed program requires no installation, is easy to use, and can be adapted for use in pharmacies, warehouses, or educational institutions. It is also advisable to use the program during practical classes in institutions with pharmaceutical and medical orientation and in educational simulation centers where future professionals are trained.

Key words: *EAN-13, check digit verification, assortment of pharmaceutical products, labeling, automated inventory control, JavaScript, HTML, pharmaceutical and medical education.*

Лілія Будняк, Анастасія Дуб, Олена Покотило, Тетяна Дядюн, Ірина Стечишин. Програмна реалізація перевірки контрольної цифри у штриховому коді EAN-13 у товарах аптечного асортименту

EAN-13 – це загальновизнаний лінійний стандарт штрихового кодування, який використовують для ідентифікації та маркування товарів, зокрема товарів аптечного асортименту. Перевірка правильності контрольної цифри штрихового коду є важливою для забезпечення точності автоматизованого обліку, своєчасного поповнення запасів та ефективного управління товарними залишками в аптечній практиці. Водночас товари аптечного асортименту, які не підлягають обов'язковій державній верифікації (наприклад, дієтичні добавки, медичні вироби, лікувальна косметика, предмети догляду за хворими), залишаються уразливими до помилок маркування, дублювання кодів і помилок під час уведення даних. Це створює ризики для точності обліку, безпеки пацієнтів та ефективності логістичних процесів, а також унеможливлює належний контроль відповідності інформації на упаковці задекларованим виробником відомостям.

Метою нашої роботи було розробити програму для перевірки контрольної цифри штрихового коду EAN-13 як інструменту базової вхідної перевірки точності маркування продукції, яка не підлягає обов'язковій верифікації, але широко представлена на фармацевтичному ринку.

У статті представлено розроблення програми для перевірки контрольної цифри штрихового коду EAN-13, реалізованої у вигляді вебзастосунку з використанням сучасних технологій HTML та JavaScript. Програма дає змогу користувачеві вводити 13-значний код, обчислювати очікувану контрольну цифру відповідно до офіційного алгоритму, зіставляти її з уведеною та оперативно повідомляти про коректність штрихкоду. Розроблена програма не потребує встановлення, є легкою у використанні та може бути адаптована до різних умов використання. Її застосування доцільне під час проведення практичних занять у закладах фармацевтичного та медичного спрямування, в освітніх симуляційних центрах і навчальних аптеках, де здійснюється підготовка майбутніх фахівців до реальної роботи з товарним обліком, маркуванням, верифікацією та ідентифікацією товарів аптечного асортименту.

Ключові слова: *EAN-13, перевірка контрольної цифри, товари аптечного асортименту, маркування, автоматизований облік, JavaScript, HTML, фармацевтична та медична освіта.*

Introduction. The use of information technologies enables the maximum automation of processes related to data collection, control, processing, analysis, and the generation of relevant documentation [1, 2]. All of this contributes to the efficient functioning of the entire chain: "manufacturer – distributor – retail – consumer".

The development of computer networks has laid the foundation for the emergence of e-commerce, which has opened up wide opportunities for the use of automated systems for the identification of goods, services, suppliers, transportation, banking operations, as well as for advertising and conducting marketing research.

Today, in the field of commerce, one-dimensional (barcode) and two-dimensional coding technologies are widely used for labeling and automated identification of goods and other accounting objects. The most commonly used are barcodes of the European Article Number (EAN) system, approved for international use and supported by the global organization GS1 (formerly EAN International).

The European Article Number EAN system is a set of conceptual principles, regulatory provisions, and standards that govern the assignment of barcodes to products, services, and locations based on unique EAN identifiers and methodological recommendations for their application.

The functional capabilities of the EAN system include:

- the assignment of unique identification codes to products, services, and business entities to ensure global identification of accounting units;
- product labeling with barcodes, enabling the automation of scanning and identification processes within accounting information systems;
- the implementation of electronic data interchange between economic entities based on a unified coding system;
- the enhancement of the efficiency of information systems responsible for automated accounting, control, and management of material and financial flows.

The most effective implementation of barcode technologies is observed in the field of retail trade. Product labeling with barcodes ensures the maximum

automation of inventory and product movement tracking – from the moment goods are received by the retail facility to the moment of their sale to the consumer. The use of automated identification based on barcode scanning contributes to the development of modern next-generation point-of-sale (POS) systems, which significantly improve the efficiency and throughput capacity of retail service points [3].

The EAN-13 linear barcode is a European barcode standard designed to encode the identifier of a product and its manufacturer. The encoded number is duplicated in Arabic numerals below the barcode and consists of 13 digits. The main difference between the European code and the American one lies in its internal structure – specifically, in the algorithm for calculating the thirteenth digit and a slight variation in the calculation of the check digit that takes this 13th digit into account. The standardization and registration of EAN codes were carried out by the European Article Numbering Association, which continued the development of standards initially created by the Uniform Code Council (UCC) in the United States and the Electronic Commerce Council of Canada (ECCC). In 2005, these organizations merged into the global standardization body GS1 [4, 5].

Barcodes have proven to be highly effective on automated production lines, where manufacturing processes are controlled by computer systems – for example, during the assembly of medical equipment that is configured with various components and mechanisms depending on the model.

The use of barcodes in the pharmaceutical industry makes it possible, during the packaging of medicinal products, to ensure full compliance between the medicine and its accompanying documentation, such as package inserts and usage instructions, as well as to determine the appropriate type of packaging.

Barcodes also allow for quality control of the products and verification of their conformity to the specified standard [6].

Barcode scanning enables manufacturers to better understand consumer preferences and to organize production and supply in such a way as to produce exactly as many goods as needed by consumers, ensuring the continuous availability of the desired product [7].

Ukraine is gradually transitioning to EU standards to ensure access to high-quality medicines and to combat counterfeit products. These standards include the protection of medicinal product supply chains and compliance with a unified coding and identification system.

The government has decided to establish and ensure the proper functioning of a national medicines verification system based on 2D coding. This system requires manufacturers to apply safety features to the packaging of medicinal products. Voluntary implementation will be allowed starting from January 1, 2026, and mandatory implementation will take effect on January 1, 2028.

Manufacturers will be required to label the packaging of medicinal products with a code containing a unique identifier. Before being dispensed to the consumer, medicines will be verified for authenticity – this will be ensured through an end-to-end verification system, including checks at the distributor level.

At the point of dispensing, the medicinal product will be scanned and checked to determine whether the information on the unique identifier matches the data submitted by the manufacturer to the centralized database. If the data matches, the code on the packaging will be deactivated and the medicine will be dispensed to the patient. If the information does not match, the system will issue a warning and classify the case as an exceptional incident. In such cases, the medicine will not be dispensed, and its verification will be handled by the competent authorities.

Labeling products entering circulation in Ukraine with a two-dimensional barcode will help ensure patients' rights to safe medicinal products and will serve as an effective tool against the distribution of counterfeit medicines in the country [8].

However, these changes apply specifically to medicinal products and not to all items in the pharmacy assortment, such as dietary supplements, medical devices, and others. Therefore, the **aim of our work** was to develop a program for verifying the check digit of the EAN-13 barcode as a tool for basic incoming inspection of the labeling accuracy of products that are not subject to mandatory verification but are widely present in the pharmaceutical market.

Methods of Research. To calculate the check digit and verify the correctness of an EAN-13 barcode, a software implementation written in JavaScript and integrated into the HTML code of a web page should be used. This approach allows the algorithm to be executed in a standard web browser without the need to install additional software.

HTML (HyperText Markup Language) was used – a markup language that defines the structure of a web page, including such elements as headings, paragraphs of text, images, tables, links, and forms [9]. In this case, the HTML structure defines the user interface, into which the barcode validation logic is embedded.

To perform the calculations, JavaScript must be applied – a programming language that adds dynamic functionality to a web page. It is used to process user-

entered data, perform mathematical calculations, and generate an appropriate result message [10].

The code itself is contained within the <*script*> tags: <*script*> *code* … </*script*>.

The program operates according to the following steps:

• a function must be defined that accepts a 13-digit barcode as a string;

• only the first 12 digits should be processed (the 13th is the check digit);

• the digits must be separated by index: odd indices (0, 2, 4, 6, 8, 10) are added to the variable *oddSum*, and even indices (1, 3, 5, 7, 9, 11) – to *evenSum*;

• the digits at even positions must be multiplied by 3, and the odd ones are added as is – according to the EAN-13 standard;

• the check digit should be calculated using the formula: *check* = (10 – (*total* % 10)) % 10, where *total* is the weighted sum of the barcode digits;

• the calculated check digit (*expectedCheck*) must be compared to the last digit entered by the user (*actualCheck*);

• if they match, a success message should be displayed (with green coloring);

• if they do not match, an error message should be shown with the appropriate visual styling (red coloring).

Discussion of Results. Verification of the check digit in the barcode using a custom-developed program enables early detection of encoding errors at the initial stage of product registration, before the assortment of pharmaceutical products is entered into the system. This approach improves the accuracy and reliability of the data, minimizes the risk of incorrect product identification, and allows flexible program customization to meet the specific needs of a particular pharmacy or distributor.

The program for verifying the check digit of the EAN-13 barcode as a tool for basic input validation of labeling accuracy for the assortment of pharmaceutical products is presented below:

```
<!DOCTYPE html>
<html lang=»uk»>
<head>
  <meta charset=»UTF-8»>
  <title>Перевірка EAN-13</title>
  <style>
    body {
      font-family: Arial, sans-serif;
      padding: 20px;
    }
    input, button {
      padding: 10px;
      font-size: 16px;
    }
    #result {
      margin-top: 15px;
      font-weight: bold;
    }
    #result.success {
      color: green;
    }
    #result.error {
      color: red;
    }
  </style>
</head>
<body>

<h1>Перевірка контрольної цифри штрихового коду EAN-13</h1>

<form id=“barcodeForm”>
  <label for=“barcode”>Введіть штрихкод (13 цифр):</label><br>
  <input type=“text” id=“barcode” maxlength=“13” pattern=“\d{13}” required>
  <button type=“submit”>Перевірити</button>
</form>

<div id=“result”></div>

<script>
  function checkEAN13(barcode) {
    let oddSum = 0;
    let evenSum = 0;

    for (let i = 0; i < 12; i++) {
      const digit = parseInt(barcode[i], 10);
      if (i % 2 === 0) {
        oddSum += digit;
      } else {
        evenSum += digit;
      }
    }

    const total = oddSum + evenSum * 3;
    const checkDigit = (10 - (total % 10)) % 10;

    return checkDigit;
  }

  document.getElementById(‘barcodeForm’).addEventListener(‘submit’, function(e) {
    e.preventDefault();
    const barcode = document.getElementById(‘barcode’).value.trim();
    const resultEl = document.getElementById(‘result’);
    resultEl.className = ‘’;

    if (!/^\d{13}$/.test(barcode)) {
      resultEl.textContent = «Будь ласка, введіть 13 цифр.»;
```

```
        resultEl.classList.add('error');
        return;
      }

      const expectedCheck =
checkEAN13(barcode);
      const actualCheck =
parseInt(barcode[12], 10);

      if (expectedCheck === actualCheck) {
        resultEl.textContent = `✅
Штрихкод правильний. Контрольний знак:
${expectedCheck}`;
resultEl.classList.add('success');
} else {
        resultEl.textContent = `❌
Штрихкод НЕПРАВИЛЬНИЙ. Очікуваний
контрольний знак: ${expectedCheck}, але
вказано: ${actualCheck}`;
        resultEl.classList.add('error');
      }
    });
</script>

</body>
</html>
```

Function for calculating the check digit:

```
function checkEAN13(barcode) {
```

Declaration of a function that takes one argument – a barcode represented as a 13-digit string.

```
let oddSum = 0;
let evenSum = 0;
```

Initialization of two variables for summation:

- **oddSum** – the sum of digits at odd positions (0, 2, 4,...);
- **evenSum** – the sum of digits at even positions (1, 3, 5,...).

In EAN terms, positions are counted from left to right: 1st, 3rd, 5th... are considered odd (but have indices 0, 2, 4 in code).

```
for (let i = 0; i < 12; i++) {
const digit = parseInt(barcode[i], 10);
```

The loop iterates over only the first 12 digits of the barcode (the 13th is the check digit):

- parseInt(barcode[i], 10) – converts the character to a digit.

```
if (i % 2 === 0) {
oddSum += digit;
} else {
evenSum += digit;
}
```

Distribution of digits into odd (oddSum) and even (evenSum) indices:

- indices 0, 2, 4, 6, 8, 10 – в oddSum;
- indices 1, 3, 5, 7, 9, 11 – в evenSum.

```
const total = oddSum + evenSum * 3;
```

Sum calculation:

- Digits at even positions are multiplied by 3;
- Digits at odd positions are added as is (according to the EAN-13 rules).

```
const checkDigit = (10 - (total % 10)) %
10;
```

Check digit calculation:

- total % 10 – takes the remainder of dividing the total by 10;
- 10 -... – calculates how much must be added to the total to make it divisible by 10;
- % 10 – ensures the result is within 0–9 in case the remainder is 0 (check digit will be 0).

```
return checkDigit;
}
```

Return of the calculated check digit.

Form submission handling:

```
document.getElementById('barcodeForm').
addEventListener('submit', function(e) {
```

Adding a submit event listener to the form.

```
e.preventDefault();
```

Preventing the default form behavior (to avoid page reload).

```
const barcode = document.
getElementById('barcode').value.trim();
```

Retrieving the entered barcode for further validation.

```
const resultEl = document.
getElementById('result');
resultEl.className = '';
```

Clearing the result class (to remove green or red coloring).

```
if (!/^\d{13}$/.test(barcode)) {
  resultEl.textContent = «Будь ласка,
введіть 13 цифр.»;
  resultEl.classList.add('error');
  return;
}
```

Validation: check if the string consists of exactly 13 digits. If not, an error message is displayed and further code execution is stopped.

```
const expectedCheck = checkEAN13(barcode);
const actualCheck = parseInt(barcode[12],
10);
```

- expectedCheck – the check digit that should be calculated based on the first 12 digits;
- actualCheck – the 13th digit entered by the user.

```
if (expectedCheck === actualCheck) {
```

Comparison: whether the check digit indicated on the package matches the calculated one.

```
resultEl.textContent = `✅ Штрихкод
правильний. Контрольний знак:
${expectedCheck}`;
resultEl.classList.add('success');
```

If they match – display a success message and apply green coloring.

```
} else {
   resultEl.textContent = `❌ Штрихкод
НЕПРАВИЛЬНИЙ. Очікуваний контрольний
знак: ${expectedCheck}, але вказано:
${actualCheck}`;
   resultEl.classList.add('error');
}
```

If they do not match – display an error message and apply red coloring.

To use the developed program in practice, it is necessary to create a file with the.*html* extension, for example, *index.html*. Open this file in a text editor (such as Notepad) and insert the code provided above. Then, save the file and open it in a web browser – the program will be ready for use.

This program can also be used in the practical component of classes in disciplines such as "Pharmaceutical and Medical commodity", "Organization and Economics of Pharmacy", "Medical and Pharmaceutical commodity", as well as "Assortment management of medical devices and commodity expertise in pharmaceutical companies".

The practical classes in these disciplines are typically undertaken by students of I. Horbachevsky Ternopil National Medical University of the Ministry of Health of Ukraine (TNMU) at the university's Teaching Pharmacy, which functions as a subdivision of TNMU's Interdepartmental Training and Simulation Center.

The Teaching Pharmacy of TNMU operates with the aim of helping students acquire and enhance practical skills in accordance with the list of competencies outlined in the draft Standard of Higher Education of Ukraine. It provides an environment for simulating real pharmaceutical processes, including inventory accounting for pharmaceutical products, quality control, identification, and labeling, thereby contributing to the development of professional competencies among future specialists.

Conclusions. 1. A software tool developed using JavaScript and HTML enables the verification of the EAN-13 barcode check digit directly in a web browser, providing a simple and accessible solution for initial labeling control of pharmaceutical products that are not subject to mandatory verification.

2. The implementation of such a tool improves data accuracy, minimizes the risk of product misidentification, and allows flexible adaptation to the needs of pharmacies and distributors.

3. The developed program can also be effectively used in practical training within pharmacy education, particularly during classes conducted at the Teaching Pharmacy of I. Horbachevsky Ternopil National Medical University, where students acquire applied skills in pharmaceutical product management and labeling verification.

BIBLIOGRAPHY

1. Неділенько В. Б., Кернаджук П. М. Застосування інформаційних технологій в управлінні конкурентоспроможністю підприємства. *Управління бізнес-процесами підприємств у контексті індустрії 4.0* : матеріали XII Всеукр. наук.-практ. конф. пам'яті проф. ТНТУ ім. І. Пулюя, м. Тернопіль, 11 жовтня 2024 р. Тернопіль, 2024. С. 76–77.

2. Інформаційні технології : навчальний посібник / Ю. В. Волосюк та ін. ; за заг. ред. А. В. Нєлєпової. Київ : Кафедра, 2017. 200 с.

3. Міністерство зовнішніх економічних зв'язків і торгівлі України. Про затвердження Рекомендацій щодо застосування технології штрихового кодування в роздрібній торгівлі продовольчими та непродовольчими товарами : Наказ від 08 квітня 1998 р. № 193. https://zakon.rada.gov.ua/rada/show/v0193204-98#Text (дата звернення: 15.03.2025).

4. Медичне та фармацевтичне товарознавство : підручник для студентів вищих навчальних закладів / І. І. Баранова та ін. Харків : Золоті сторінки, 2017. 320 с.

5. Калушка О. Б., Грошовий Т. А., Знаєвська А. В., Демчук М. Б. Медичне та фармацевтичне товарознавство : посібник. Тернопіль : Укрмедкнига, 2017. 484 с.

6. Гридасов В. І., Оридорога Л. М., Винник О. В. Фармацевтичне і медичне товарознавство : посібник. Харків : Золоті сторінки, 2002. 160 с.

7. Ідентифікація та штрихове кодування. https://gs1ua.org/systema-gs1/identyfikatsiia-ta-shtrykhove-koduvannia/ (дата звернення: 15.03.2025).

8. 2D-кодування ліків. https://www.dls.gov.ua/for_subject/155635-2/ (дата звернення: 15.03.2025).

9. Павленко Ю. С. Верстка вебсторінок із допомогою HTML та CSS / Методичні рекомендації до першого модуля нормативної дисципліни «Програмування та підтримка вебзастосувань». Луцьк : ВНУ імені Лесі Українки, 2022. 65 с.

10. JavaScript® and jQuery® for Data Analysis and Visualization / J.J. Raasch, G. Murray, V. Ogievetsky, J. Lowery. Indianapolis, IN, USA : John Wiley & Sons, Inc, 2014. 432 p.

REFERENCES

1. Nedilenko, V., & Kernadzhuk, P. (2024). Zastosuvannia informatsiinykh tekhnolohii v upravlinni konkurentospromozhnistiu pidpryiemstva [Application of information technologies in the management of enterprise competitiveness]. Materials of the XII All-Ukrainian Scientific and Practical Conference in memory of Mykola Chumachenko, Honorary Professor of Ivan Puluj Ternopil National Technical University, Academician of the National Academy of Sciences of Ukraine: "Business Process Management of Enterprises in the Context of Industry 4.0», 11 October 2024, Ternopil, 76–77. TNTU [in Ukrainian].

2. Volosyuk, Y. V., Kuzioma, V. V., Kovalenko, O. A., Tykhonova, T. V., Nielepova, A. V., Bondarenko, L. V., Moroz, T. O., & Boryan, L. O. (2017). Informatsiini tekhnolohii: Navchalnyi posibnyk [Information Technologies: Textbook] (A. V. Nielepova, Ed.). Kyiv : Kafedra [in Ukrainian].

3. Ministerstvo zovnishnikh ekonomichnykh zv'iazkiv i torhivli Ukrainy. (1998, April 8). Pro zatverdzhennia Rekomendatsii po zastosuvanniu tekhnolohii shtrykhovoho koduvannia v rozdribnii torhivli prodovolchymy ta neprodovolchymy tovaramy: Nakaz No. 193. Retrieved from https://zakon.rada.gov.ua/rada/show/v0193204-98#Text [in Ukrainian].

4. Baranova, I. I., Kovalenko, S. M., Semeniv, D. V., Breusova, S. V., Bezpala, Y. O., & Dyadiun, T. V. (2017). Medychne ta farmatsevtychne tovaroznavstvo: Pidruchnyk dlia studentiv vyshchykh navchalnykh zakladiv [Medical and Pharmaceutical Commodity Science: Textbook for students of higher education institutions]. Kharkiv : NFaU : Zoloti storinky [in Ukrainian].

5. Kalushka, O. B., Groshovyi, T. A., Znaievska, A. V., & Demchuk, M. B. (2017). Medychne ta farmatsevtychne tovaroznavstvo [Medical and pharmaceutical commodity science]. Ternopil: Ukrmedknyha [in Ukrainian].

6. Hrydasov, V. I., Orydoroha, L. M., & Vynnyk, O. V. (2002). Farmatsevtychne i medychne tovaroznavstvo: Posibnyk dlia studentiv vyshchykh navchalnykh zakladiv [Pharmaceutical and Medical Commodity Science: A textbook for students of higher education institutions]. Kharkiv: NFaU : Zoloti storinky [in Ukrainian].

7. Identyfikatsiia ta shtrykhove koduvannia [Identification and barcode labeling]. Retrieved from *https://gs1ua.org/systema-gs1/identyfikatsiia-ta-shtrykhove-koduvannia/* [in Ukrainian].

8. 2D-koduvannia likiv [2D coding of medicines]. Retrieved from https://www.dls.gov.ua/for_subject/155635-2/ [in Ukrainian].

9. Pavlenko, Y. S. (2022). Verstka veb-storinok z dopomohoiu HTML ta CSS: Metodychni rekomendatsii do pershoho modulia normatyvnoi dystsypliny "Prohramuvannia ta pidtrymka vebzastosuvan" [Layout of web pages using HTML and CSS: Methodological recommendations for the first module of the normative discipline "Programming and support of web applications"]. Lutsk : Lesia Ukrainka Volyn National University [in Ukrainian].

10. Raasch, J. J., Murray, G., Ogievetsky, V., & Lowery, J. (2014). JavaScript® and jQuery® for data analysis and visualization. Indianapolis, IN: John Wiley & Sons, Inc.