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BAR CODE IMPLEMENTATION IN THE PHARMACY OF A NEW HOSPITAL

C. LACASA, C. ROURE, J.M. AIRA, N. ALGUERSUARI, J. LARROYA, C. HUMET.
Hospital de Barcelona, Diagonal 660, 08034 Barcelona, Spain.

1 INTRODUCTION

Computerized information systems are increasingly being implemented in hospital pharmacies as management aids[1,2,3,4]. Furthermore, the heading of "personnel" accounts for approximately 60-80% of hospital costs, and thus measures which increase productivity, such as mechanization of services, have an even greater effect on costs.

The use of bar codes (BCs), in particular, not only leads to a decrease in staff time for certain tasks, but also a reduction in the number of errors that may occur when introducing data in automated systems.

BCs consist of a predetermined sequence of rectangular dark bars alternating with empty spaces. These represent characters (letters, numbers or symbols) and may be detected by a reader and processed by automated systems.

The code is read by a light source (reader or scanner). Light is reflected differently by the dark bars than by the empty spaces. A detector perceives the light reflected and produces an electronic signal that is later decoded and converted to a digital signal and transmitted to a computer or printer[5].

The BC symbols contain a silent zone, a starting character, the characters that contain the information, the finishing character and another silent zone (figure 1). The silent zone contains no information. The starting and finishing characters signal the reader when to begin and end the reading process and inform in which direction the code should be read[6].

BC symbology dates to 1949; however, it was not implemented on a large scale until 1970, when the Universal Product Coding (UPC) system was adopted by the food industry in North America. This was the industrial sector that introduced this technology, and also the one which has made the most use of it. Other sectors have followed this example, in each case adopting the BC system best suited to its needs.

Some of the more utilized BC systems, in addition to the UPC, are Codabar, used by the American Blood Commission to identify blood derivatives, Code 93, Code 128, the so-called Code 2 of 5 and Code 39, also known as Code 3 of 9[5].

In 1983 the American Hospital Association and the Health Industry Distributors Association proposed a standard BC model for the health industry, called the Health Industry Bar Code (HIBC). This model was approved by the Health Industry Bar Code Council in 1985[6], and indicates the format and type of data to be encoded. All the specifications dictated by the HIBCC are used by programmers and BC equipment manufacturers and serve the user by letting him or her know the level of service he or she may expect from this type of technology.

A parallel organization has recently been created in Europe and is known as the European Health Industry Bar Code Foundation (EHIBCF)[7].

The type of BC chosen by both organizations for encoding products is Code 39, since it has a series of characteristics that render it especially appropriate for application in the health-care industry:

- It is very reliable, it has a security digit and has shown a very low percentage of errors wherein one character is read for another (fewer than 1 in 10,000,000).
- It uses numeric, alphanumeric and special characters, and thus has great versatility.
- It allows bidirectional reading and has a series of characteristics that facilitate printing[5].

The Asociación Española de Codificación Comercial (Spanish Association for Commercial Encoding) exists in Spain, and has been responsible for the implementation of BC in pharmaceutical specialties[8,9].

BCs have multiple applications in hospitals. They may be used in nearly every department, especially in those that receive products, for inventory control, invoicing, dispensing quality control, etc. However, user services may also benefit from BC, especially in aspects related to quality control, documenting administration to patients, etc.[10,11,12].

In **Hospital Pharmacy**, the bibliography cites numerous applications for BCs: controlling stocks, controlling expiration dates, patient invoicing, pharmacy preparations, i.v. additive labels[13-17], repackaging, control of psychoactive drugs and narcotics, restocking of emergency carts, quality control[18,19] and others.

The aim of this study is to describe 11 months of experience (June 1989-April 1990) in using BCs in the pharmacy of the Hospital de Barcelona. This is a new, private, 205-bed hospital covering all medical specialities, in the process of expanding to a 411-bed operation. It is an open hospital that serves a population of 235,000 privately insured patients. Sixty-five percent of admittances are

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2 MATERIAL AND METHODS

Material

We used the hospital's main computer, an IBM 4381-23, 16 MB with 85 screens, ten personal computers and 44 printers (two of which are thermal for printing BCs), which serves 320 users. The pharmacy has three terminals (one of which is connected to an optical BC reader) and three printers (two for work lists, messages, etc., and one thermal).

The labels for imprinting the BCs were specially manufactured to allow correct printing and reading, and the paper used has the appropriate level of humidity so that they may be easily stuck to and unstuck from the drugs and printed forms.

The hospital has a pneumatic tube system for the horizontal and vertical distribution of drugs from the pharmacy.

Methods

1. Programs

All programming was done by the PADSA company. The first phase of implementation was performed in conjunction with the Purchasing Dept.

2. Master List

Prior to hospital opening, a master list of drugs with the following data was recorded:

- Internal drug codes. This consists of seven digits, the first two of which identify the therapeutic group to which the drug belongs. An internal code was chosen in order to be able to use the same BC reading system and programs that are used in the rest of the hospital products (health-care, laboratory and food materials and paper goods, etc.). As is known, the Spanish pharmaceutical industry uses BCs in multiple packages, but not yet in single-dose packages.
- Generic names. This was used for all drugs with a common international denomination, followed by the drug's presentation (pharmaceutical form, dosage and units of measure). Drugs were organized in the pharmacy and in nursing units by alphabetical order of the generic name.
- Trade names. These were indicated only as assigned by suppliers, and the corresponding national code is also registered.
- Characteristics. Drugs requiring refrigeration, psychoactive drugs, narcotics and inflammable products were differentiated.
- Therapeutic class. Drugs were organized by ATC classification. Foreign drugs and reagents for pharmacy preparations were assigned code numbers from a special group.
- Other data. Other data useful for controlling drug stocks (expiration date; if the drug is to be invoiced by patient or by cost center; if it is temporarily or permanently included in stock; if its use is restricted) were also included.

3 CONTROLLING STOCKS

- Purchase orders. These were mechanized in accordance with stock in the storeroom, and purchase requisitions are now generated automatically, with written, numbered purchase orders issued.
- Drug receiving. The date of receipt, supplier's name, commercial name and number of units are recorded; internal packing slips are generated automatically.

4 DRUG LABELING

Each drug unit received in the pharmacy is labeled individually to include the following information: numeric code; the corresponding BC symbol; generic name; pharmaceutical form; dosage; and expiry date (figure 1). The encoding system used is Code 39.

5 DRUG DISTRIBUTION

Special Services

Special services departments (Intensive Care, Surgical Units, Emergency Room, Radiology, Scanner, Complementary Explorations, Laboratory, Neonatal Unit and Delivery Room) operate with a fixed quota of drugs that are used with greater frequency and which are periodically restocked. The labels from the drugs used are attached to patients' data sheets, which are sent to the pharmacy for restocking.

In the pharmacy, the BCs are read and recorded by an optical reader, and drug restocking lists are obtained for each special service department. These drugs are then prepared and distributed.

Unit Dose

Drugs are distributed in unit doses to all hospital units. Patient identification is done by labels which include the following information: clinical history number; case number with its corresponding BC; patient name; and date of admittance. These labels are made in Admitting and automatically routed to the different departments when a patient is admitted. They are used to identify each drawer in the single-dose drug distribution cart (figure 2).

This manner of ordering[20] completely avoids the need for transcription in the pharmacy and nursing units. The original order remains in the clinical history of each patient, the second copy in the nursing Cardex and the third in the pharmacy. The pharmacist reviews the orders and auxiliary personnel prepare the drug carts.

During the preparation of the single-dose drug

carts, the auxiliary personnel remove the BC labels from each drug unit prescribed and place them on the corresponding drug-use sheet of the patient (figure 3). When a drug is returned due to suspension of treatment, the reverse procedure is followed.
Each patient's drug use is thus registered in the computer, as is the use of stock (patient labels, as well as drug labels, are read by the optical reader). At present, we are proceeding with the complete mechanization of the single-dose drug distribution system (recording of orders in the computer and obtaining lists of pharmaco-therapeutic histories, preparation in the pharmacy and nursing use).
Some drugs are prescribed conditionally, depending on a clinical state (for example, analgesics when necessary), from the hospital supplies, and in this case it is the nurse who removes the label and sends the corresponding sheet to the pharmacy for restocking of the drug.

Emergency carts
The pharmacy and the Nursing Unit Supervisor are responsible for the preparation and periodic review of the emergency carts. The carts are sealed off with a seal labeled for a single use, whose control and renewal are performed by the pharmacy along with the Nursing Supervisor, including health care materials; each cart is treated as a separate unit for purposes of the computer.

6 INVOICING

Patients
All drugs administered to patients are recorded in the computer, as has been indicated. Private patients are invoiced immediately, invoicing only the drug doses that they have been administered, both by nursing and in the different special services departments (emergency room, surgical units, intensive care, etc.).

Cost centers
Drugs whose costs are charged to nursing (e.g., povidone iodized surgical soap) are invoiced to the corresponding cost center.

7 DRUG UTILIZATION REVIEWS

Drug utilization reviews have been carried out by "searching" on the computer for each drug and converting to a defined daily dose (DDD).

8 RESULTS

8.1 Master list
In April 1989 the data from 762 generic drugs corresponding to 1,202 presentations of drugs were recorded, which formed the database necessary for the mechanization process.

8.2 Stock control
1,465 orders were placed with suppliers and 3,187 drug shipments received. 402,780 drug units were labeled with BCs.

8.3 Drug distribution

Special services
92,595 units were dispensed to restock special services departments (table 1) in the study period. The number of drugs accepted for each department could be considered high, but is justified by the pharmacy's working hours, which were 14 hours daily during the study period. The pharmacy is currently open 24 hours, and the number of drugs provided to each department is now being reviewed.

DEPARTMENT	NO. OF DRUGS	TIMES DISPENSED
UH03	76	4,675
UH04	96	6,009
UH05	99	4,391
UH06	115	4,767
UH08	80	1,446
UH09	103	1,956
NURSERY	32	710
LABORATORY	13	923
COMPLEMENTARY EXPLORATIONS	50	722
RADIOLOGY	73	1,197
SCANNER	51	462
OPERATING ROOM	191	23,989
STERILIZATION	10	636
DELIVERY ROOM	107	1,868
INTENSIVE CARE	197	25,847
NEONATOLOGY	68	3,429
EMERGENCY ROOM	292	9,556
There are 16 emergency carts stocked with 25 drugs and 40 health-care items. UH = Hospital Unit		

Table 1 - Drug Supplies and Dispensing

Unit dose
This distribution system has been implemented in the six hospital units operating thus far. Medication was dispensed to 2,280 patients admitted during the study period.

Emergency carts
Thirty-eight reviews and the corresponding sealing off of the carts were carried out in conjunction with the nursing supervisors.

Invoicing
A total of 2,280 patients were invoiced for drugs.

Drug utilization reviews
A total of 4,657 DDD of antibiotics were dis-

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9 CONCLUSIONS

- The application of BC technology in the pharmacy has been extremely useful in its internal administration.
- It has reduced the number of staff devoted to recording drug stock withdrawals in the computer, specifically administrative personnel, since the BC optical reader does not require special training.
- It has facilitated quality control in dispensing single doses.
- The issuing of BC labels, as well as drug repackaging, is a delicate task which should always be supervised by a pharmacist.
- The restocking of drugs in special services departments is done much more rapidly utilizing this technology than had been done with classical systems.
- The Spanish pharmaceutical industry should collaborate with hospitals in this effort by incorporating BCs on all products.

This work would not have been possible without the collaboration of the pharmacy and nursing staff of the Hospital de Barcelona, whom we thank.

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Figure 1
Single-dose drug distribution cart showing details of patient identification label.

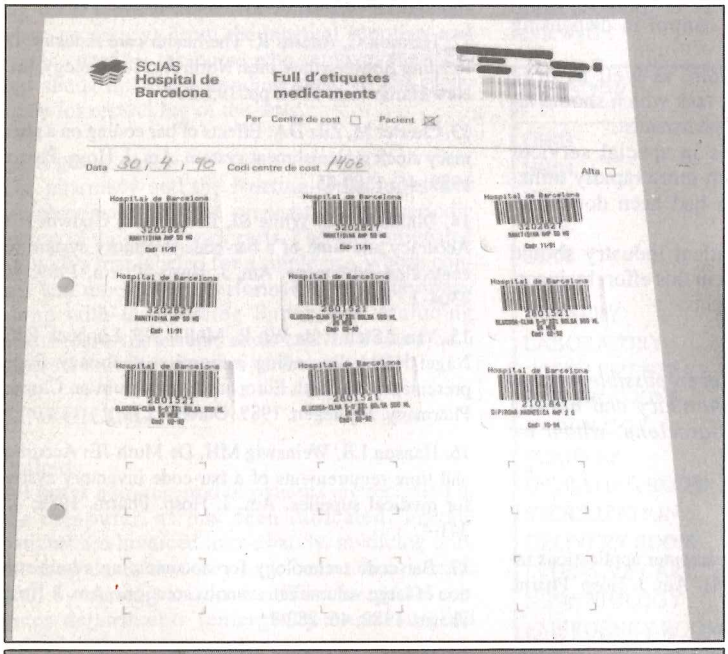


Figure 2
Drug-use sheet of a patient with bar code labels.

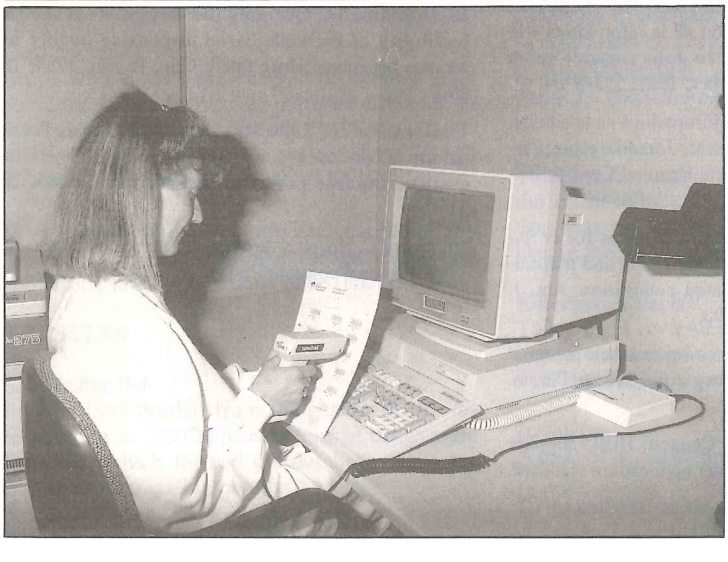


Figure 3
Pharmacy technician staff during the label reading process.

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