Bar Coding and Tracking in Pathology

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KEYWORDS
• Bar codes • Tracking • Pathology informatics • RFID

ABSTRACT

Bar coding and specimen tracking are intricately linked to pathology workflow and efficiency. In the pathology laboratory, bar coding facilitates many laboratory practices, including specimen tracking, automation, and quality management. Data obtained from bar coding can be used to identify, locate, standardize, and audit specimens to achieve maximal laboratory efficiency and patient safety. Variables that need to be considered when implementing and maintaining a bar coding and tracking system include assets to be labeled, bar code symbologies, hardware, software, workflow, and laboratory and information technology infrastructure as well as interoperability with the laboratory information system. This article addresses these issues, primarily focusing on surgical pathology.

OVERVIEW

Bar codes are standardized identification tools that allow for asset tracking. They have widespread use in point of sale purchases, delivery companies, automobile industry, and health care. With advances in technology over the past few decades, there have been tremendous improvements in bar code and scanner performance. Some of the main purposes of implementing a bar coding and tracking system are to reduce errors and increase efficiency. Instead of manual logging entries, bar coding has reduced human errors by automating identification and tracking. Regarding health care, bar coding is a hospital-wide operation. From patient wristbands to hospital beds, different bar codes or RFID tags are used to identify, locate, and audit labeled assets.

The clinical laboratory has demonstrated positive effects of implementing bar coding and tracking systems.[1–6] Similar use of this technology, however, has only recently been introduced in anatomic pathology. Ever-increasing specimen volumes, complex testing, and a desire for decreased turnaround times without increasing costs and errors provide a pressing impetus for pathology laboratories to implement tracking solutions. There are myriad pathology assets that can be identified and tracked, including order requisitions, specimen containers, tissue cassettes/blocks, glass slides, and reagents. Interfacing bar codes or RFID tags with the LIS have become essential for contemporary pathology laboratories to reap the benefits of asset tracking, such as driving workflow, automation, error reduction, digital pathology, and improved patient safety.

HISTORY

Bar codes, which are ubiquitous today, made their debut approximately 80 years ago (**Table 1**). The first mention of bar coding was US patent 1985035A, published on December 18, 1934, by John Kermode, Douglass Young, and Harry Sparkes. Their patent included "sorting machines which employ photo-electric cells or other light-responsive means for sorting cards, records or the like in response to a code or designation marked thereon, or for tabulating, recording or effecting other controls in accordance with the marks on the cards or records." In October 1949, Norman Woodland and Silver Bernard filed a patent (US patent 2612994A), which delineated the first bar code process, entitled "Classifying apparatus and method." Bernard and Woodland were devising a method to automatically scan products at grocery stores to

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Table 1
Historical events of bar codes

Date	Event
December 18, 1934	US patent 1985035A is the first mention of bar code technology
October 20, 1949	US Patent 2612994A filed, describes the first bar code process
1961	Color bar codes first used on railroad cars
June 23, 1973	Announcement of the first UPC point of sale system
June 26, 1974	First product bar code scanned in a supermarket (Wrigley gum)
September 21, 1981	US Department of Defense adopts Code 39 bar code
September 1982	US Postal Service use POSTNET bar code to represent zip codes
1987	ISO 9000 quality management standards first created
February 2004	US Food and Drug Administration requires medications use bar codes
October 12, 2005	AABB requires ISBT 128 bar code for accreditation

Abbreviations: AABB, American Association of Blood Banks; POSTNET, Postal Numeric Encoding Technique.
Adapted from UPC History. ID History Museum.[7]

minimize time in checkout lines. Woodland eventually continued developing bar codes at IBM. The earliest bar coding system was used in a railroad company to identify railroad cars, called KarTrak automatic car identification. This color bar code system has many similarities to bar codes in use today. KarTrak used 13 horizontal labels of different width and spacing, a start and stop line, and a line checker. Due to high human reading error rates, however, their system was abandoned in the 1970s. The supermarket industry started using candidate bar code formats for automated checkout systems in the mid-1960s. In 1973, after many ad hoc committee meetings, the uniform product code (UPC) was designated the national standard by the National Association of Food Chains for grocery product identification. The International Organization for Standardization (ISO) 9000 quality-management standards, first created in 1987, have pushed companies to ensure compliance with bar coding systems.[7–9] Because of these advancements, bar codes have a global presence. Health care subsequently also widely adopted bar code technology.

TYPES OF BAR CODES

A bar code is defined as an optical machine-readable symbol representing a set of data. Bar codes use light reflection on different-sized white and black bars or dots to encode a binary (1s and 0s) string of data. There are hundreds of different bar code varieties that can be created, most of which are grouped into categories of a linear (1-D) or 2-D bar code symbology (**Fig. 1**).

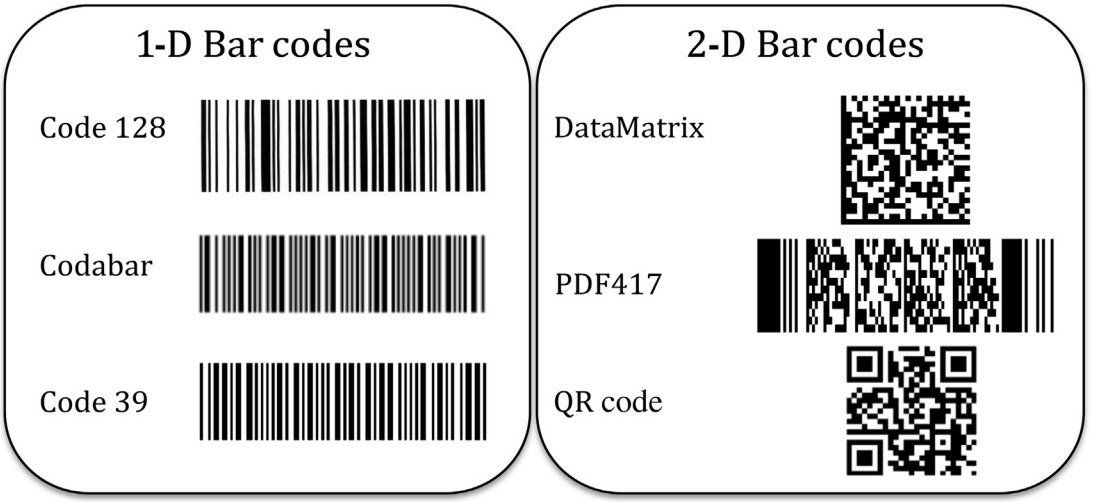

Fig. 1. Linear (1-D) and 2-D bar code symbology examples. 1-D bar codes with data encoded only on the horizontal axis are represented by differentially spaced and sized line bars. 2-D symbologies are represented as black and white dots with data encoded along the vertical and horizontal axis.