

# Evaluating Print Options for Hospital Bar Code Labeling



A ZEBRA BLACK & WHITE PAPER






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## Executive Summary

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Quality care depends on quality information. That's why many hospitals are implementing bar code systems to deliver accurate information in a variety of patient care and clinical settings. Bar codes are important for improving patient safety and process efficiency. Therefore, they should be created with care using dedicated printers that are optimized to provide reliable, accurate bar code output.

Thermal label printers produce high-quality bar codes for patient wristbands, unit-of-use medication marking, sample and file tracking, prescription labels, and other healthcare applications. When hospitals start planning their first bar code labeling applications, they are often tempted to try to modify their existing office printing systems to do the job. While laser, ink jet, and dot matrix printers can be made to output bar codes, dedicated thermal printers are a much more convenient and cost-effective option.

This white paper will explain why a dedicated thermal printer is the superior choice for bar code label printing in hospitals. The paper will:

- Provide an overview of thermal printing technology;
- Highlight thermal printing advantages for patient care and pharmacy operations;
- Describe the bar code printing capabilities and limitations of thermal, laser, ink jet, and dot matrix print technologies;
- Explain how thermal printer networking, connectivity, product design, and other features improve productivity of the printer and operator; and
- Illustrate why thermal printers are generally more cost-effective for labeling than other technologies.

A dedicated thermal label printer provides quality, convenience, and cost effectiveness to the user. Many bar code printers do not need special programming or font add-ons to produce all the bar code formats needed for hospital applications. Thermal printers support a variety of label materials to meet these needs without jamming the printer or wasting media. Thermal bar code printers can easily accept and encode variable data without severely slowing print speed, can produce small labels to exacting tolerances, and offer a full range of PC, network, and wireless interfaces for convenient connection and management in any IT environment.

## Benefits to Operations

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Thermal, laser, dot matrix, and ink jet print technologies each create bar codes in their own unique way. The thermal method is not just different from other technologies, it is advantageous. The main advantages are performance, convenience, and cost. The precise bars and spaces required for bar code printing, especially for curved wristbands, small medication doses, and other specific healthcare needs, demand higher print quality than is usually required for text printing on document printers. Encoding variable data or producing two-dimensional (2-D) symbols or very small bar codes makes bar code printing much more challenging, and is beyond the capabilities of some print technologies. Many document printers simply aren't as effective for this type of output as they are for printing text.



## **Total Cost of Ownership**

Thermal printing quality provides total cost of ownership (TCO) advantages over other print technologies. Because printheads and other components are designed for printing bar code labels, rather than documents, labeling operations will not add excessive wear to the equipment or lead to premature repair and replacement. Using non-thermal printers results in more time being spent replacing parts, setting up new printers, clearing label jams, and swapping plain paper and label media, which reduces productivity and adds to the cost of the printing system. Thermal printers are built to better withstand dirt, dust, moisture and vibration and should last longer than printers designed to be used in offices.

Because thermal printers accept the widest variety of media of all the print technologies, including polyester and other durable label stocks, they can be used to create asset identification and other permanent labels on demand, and eliminate the need to purchase preprinted labels or sheets of labels, as used in document printers. Sheet printing is extremely wasteful for unit-dose, prescription, and wristband labeling.

Thermal printers run reliably and can produce bar codes and labels without special handling, which provides many ongoing cost-saving and efficiency advantages. The advantages begin for IT staff who install and support hardware and develop applications, and extend to the people who use the printer on a regular basis.

## **Support and Ease of Use**


Using dedicated printers for label generation prevents delays and saves labor associated with multi-purpose print operations. If labeling responsibilities are added to an office printer, label jobs may get stuck in a lengthy print queue while documents and reports are being printed. Using a document printer for label generation requires label media to be loaded each time labels are needed, and the plain paper to be replaced afterward. The process may be repeated several times each day, resulting in costly lost productivity for pharmacists, nurses, technicians, and other personnel.

Thermal bar code printers are designed to print labels and typically have a Windows® driver, which allows integration into Windows-based applications without requiring specialized programming knowledge. There are dozens of labeling software packages that can drive specific types of thermal printers. These packages can automatically encode data, size and generate bar code symbols, simplify label layout and design, perform data integrity checks, and interface with a variety of databases, healthcare information systems, Windows applications, and other systems to gather the data necessary to generate bar code labels. These features save hours of expensive programming time that other print technologies may require to develop special graphics and data handling applications for bar code output.

Bar code label formats can be stored directly in the thermal printer's memory, which improves processing and print speed. Bar code printers are also available with control panels that enable labels to be created directly from the printer without any connection to a PC, so there are no additional costs for equipment purchase and support.

Even though a thermal bar code printer is a specialized tool, it does not need to represent a special burden to IT support operations. Thermal printers are available with parallel, serial, twinax, coax, Ethernet, USB, Bluetooth® and 802.11b interfaces for connection to any enterprise IT environment.

Advanced printers can be assigned an IP address and integrated into networks through either a wired or wireless connection, so they can receive print jobs and be managed like any other device on the network. Furthermore, advanced bar code label printers have networking features that enable remote configuration and management



and proactively send notification to network administrators when media runs out or other error conditions exist, which minimizes downtime and support requirements. These productivity-enhancing features are very valuable when printers are used for time-sensitive or high-volume applications.

## Print Technologies and Bar Coding

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To understand and appreciate the benefits that thermal technology has over other methods for bar code label production, you need a basic understanding of bar code symbols and how each print technology produces them. Scanners decode the information from bar codes by measuring the differences between narrow and wide elements, and the contrast between dark bars and light spaces. If the ratios or contrast are off, the bar code may be difficult or impossible to read. The potential consequences of errors or incomplete information for patient safety applications are simply too dangerous to risk insufficient symbol quality. Poor-quality symbols also result in repeated scan attempts, which lowers productivity, frustrates staff, and may cause them to bypass bar code control processes.

### Laser


Laser printers work much like photocopiers; they project controlled streams of ions onto the surface of a print drum, resulting in a charged image. The charged image then selectively attracts toner particles, transferring the image onto the paper substrate by means of pressure. The pressure from the printhead and drum then fuse the image to the paper, creating the image.

### Advantages

- Laser printers are good at producing plain-paper documents that require bar codes.
- They can print high-quality text and graphics on paper documents and can double as a document printer when not being used to print bar codes.
- Bar code density and resolution are also quite high on laser printers, resulting in high-quality symbols.

### Limitations

- Laser printers can be wasteful because they cannot produce single or small labels. A minimum of half a page of media is typically required for the printer to maintain control of the sheet. Unless the label is at least that size, or multiple labels are needed at once, the remainder is wasted.
- Laser printer label adhesives must be carefully selected to ensure stability under the heat and pressure of the fuser. Otherwise, the adhesive may seep onto the printer mechanism, where it will capture stray toner, or may cause the labels to curl at the edges.
- Because of the pressures used in the image-transfer process, many laminated label materials are not compatible with laser printing.
- A laser-printed paper label has limited durability. Laser printers cannot produce chemical- or water-resistant labels and images.
- With laser printers, toner, drum, and supply costs can skyrocket when printing bar codes instead of typical text. While text printing requires only about 5 percent black toner, bar code needs can exceed 30



percent to ensure proper contrast between dark and light elements. Toner costs alone could be six times higher when printing bar codes rather than text.

## **Thermal**

Thermal printing is classified as either direct thermal or thermal transfer. The two technologies are suited to different applications. Direct-thermal printers create images by using a printhead to apply heat directly to chemically treated label media. There is no ribbon or ink required. In thermal-transfer printing, the printhead heats a ribbon, which melts the image to the material. Thermal transfer is used for high durability, long-lasting labeling applications. Direct-thermal printing is the technology of choice for most applications. Direct thermal is especially popular for wristband printers, because there is no ribbon to destroy to comply with HIPAA patient privacy requirements.

## **Advantages**

- Thermal enables batch or single label printing with virtually no waste.
- Thermal printers are typically built more durably than dot matrix, ink jet, or laser printers, allowing reliable operation in lab, nursing station, patient bedside, and pharmacy environments.
- Direct-thermal printing produces sharp print quality with good readability.
- Thermal-transfer printing produces long-life image stability.
- Direct-thermal printers are simple to operate compared to most other print technologies, with no ink, toner, or ribbon to monitor and replenish.
- With no supplies to replace other than the material to be printed, long-term maintenance costs and total cost of ownership remain low for direct-thermal printers.
- Direct-thermal printers have no ribbon disposal requirements to satisfy HIPAA compliance.

## **Limitations**

- Paper labels produced by direct-thermal printing are sensitive to environmental conditions such as heat and light. Long-term exposure to fluorescent light can reduce bar code quality. However, top-coated media is available on many paper and synthetic label materials to mitigate these effects, and direct-thermal labels are often fully capable of meeting medication marking needs.
- Thermal printers accept roll media and cannot print 8 1/2- by 11-inch documents.

## **Dot Matrix**

Dot matrix print technology is one of the oldest techniques used for on-site label printing. The typical dot matrix bar code printer is a modified line printer requiring pin-feed paper stock. Solenoid-driven needles strike an ink-coated nylon ribbon, transferring ink onto the paper or label. The image is built up dot-by-dot in a matrix as the needle and paper are moved relative to one another.



## Advantages

- Dot matrix printers are readily accessible and inexpensive to purchase.
- They can print on virtually any type of form, check, or document, and can print on wide-web, multi-part (carbon) forms.
- Dot matrix printers use multi-pass ribbons, which can result in reduced overall cost for ribbons and label material.

## Limitations

- Dot matrix printers print low- to medium-density bar codes that may not meet some application requirements. The dot size on the matrix printer limits the size of the narrow element in the bar code, which restricts symbol density options and makes it difficult to produce small bar codes.
- Media options are limited to paper, which is insufficient for many applications.
- Continuous ribbon re-use on dot matrix printers requires close monitoring of ribbon condition to ensure adequate bar code contrast. Ribbon ink that has become exhausted can also produce an image that is inadequate for scanning, resulting in a low read rate and high error rate.
- Ink saturation can result in paper “bleed,” which can cause image distortion, such as bars becoming too wide and thus unreadable.
- A dot matrix-printed label has limited durability and media choices are restricted. Dot matrix printers typically cannot print on chemical- or water-resistant labels.
- Printing single labels results in significant waste. The design of the dot matrix printer’s print carriage, sitting far below the media, also does not allow users to maximize the label space.
- Print speed is greatly reduced when best ink coverage is specified for optimal bar code print quality.

## Ink Jet

Desktop ink jets are a common and inexpensive choice for printing documents from home computers and in offices.

## Advantages

- Desktop ink jet printers are inexpensive to purchase and easy to replace.
- Sheet-cut adhesive label material for desktop ink jets is readily available from office supply stores and catalogs.
- Many hospitals already have ink jet printers for document printing.



## Limitations

- Many desktop ink jet printers can only print labels by the sheet, resulting in waste and inefficient handling required for loading and handling label material.
- Processing variable data and formatting bar codes significantly slows print speed. Productivity suffers when operators must wait for labels to come out of the printer.
- There is limited bar code and label design software support for desktop ink jet printers.
- Media options are limited to paper, which is insufficient for many applications.
- Durability and reliability are limited when desktop ink jet printers are used in non-office environments. Desktop ink jet printers are not designed to withstand dust, dirt, vibrations, and other environmental conditions common in shipping areas, which leads to increased maintenance and reduced lifespan.

## Conclusion

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To evaluate whether your bar code printing needs can be satisfied with existing equipment or would benefit from a dedicated label printer, consider the following:

- What is the expected print volume and how will that impact operator and printer productivity?
- Can existing printers efficiently produce the required label size?
- Can the printer support all required bar code formats?
- Can the printer support the range of media needed for all labeling applications and storage conditions?
- What are the expected monthly supplies costs?
- Is print quality important? What will happen if bar codes are unreadable?
- How much initial setup and programming time is required? Can it be done in-house?
- How much ongoing IT support and operator time will be required to use and maintain the system?
- If label requirements change, can modifications be made internally or will outside support be required?
- Can the equipment printer in the environments where labels are needed?
- How will bar code label printing impact equipment performance? How often will printers need to be replaced or repaired?



Thermal bar code label printers are built to satisfy these concerns. From their initial setup, to daily use and long-term maintenance, dedicated thermal printers are the most cost-effective and convenient option for bar code labeling. Users can enjoy operating-cost, ease-of-use, and reliability benefits whether they print a few labels a week or hundreds of labels a day. Bar coding is a sophisticated print operation that requires a specialty printer. Dozens of printer models are available to precisely satisfy different user requirements for print volume, speed, symbologies, label materials, interfaces, and other features.

Zebra Technologies is a world leader in bar code, RFID, and ID card printing with an installed base of more than 4 million units, including systems at healthcare facilities for unit-of-use labeling, prescription label printing, patient wristband printing, materials management, security, and employee identification. Together with its partners, Zebra has the experience, industry knowledge, and specialized products needed for successful pharmacy implementations. Zebra is also a leader in standards development that actively participates in the work of life sciences industry associations so that it will be prepared to meet the emerging needs of its customers. Contact Zebra at +1 800 423 0442 or visit [www.lifesciences.zebra.com](http://www.lifesciences.zebra.com) for more information about bar code printing solutions for healthcare.



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