

Bar Codes and Bar Code Scanners for Unit-Dose Medications in a Healthcare Setting

In action, bar codes look like a magic trick. With a simple pass by a scanner the bar code unlocks hidden information, sets in motion actions making commerce easier, and can even prevent mistakes from happening. While not actually magic, bar codes are an important part of systems that do some incredible things. They are particularly good in fast paced environments, where the cost of errors are high, and the demands on the attention of overworked staff are monumental, like always delivering the right drug, and the right dose, at the right time, via the right route, to the right patient...all while juggling countless other issues and pressing concerns. This sounds like the perfect place for a system that quickly verifies all this information against orders that were carefully documented by a trained professional! Because Medi-Dose®/EPS® specializes in printing unit-dose medication labels with bar codes, this is the type of situation we have in mind here while discussing bar codes and scanners.

How Bar Codes Work

Ultimately, a bar code is just text encoded in a special pattern that a bar code scanner can read. When you scan the bar code, the scanner converts it back into characters and enters them into a program, just as if you typed those characters with a keyboard. The magic happens in the program that uses those characters to look up a record. At the store, this would be a UPC Code that links to information like the product name and price, which the software uses to add the price to a bill, and then subtract the item from inventory. With medications, this is often an NDC number that links to information like the generic name and strength, which the software might use to warn a nurse they are trying to administer the wrong medication, or to add that dose to a patient's record.

In both situations above, the bar code only contained a number that identified the item. The software matched that number with a record that has detailed and useful information. The bar code and scanner only eliminated the need to type in the number without error, and then the software used that information to perform the desired function.

Scanners

A scanner, the tool that reads the bar code, is often attached to a computer or device that has the software running. In some cases, like handheld devices that provide drug interaction information, the software is built right into the scanner. 1-D and 2-D are the two most common types of scanners. Each has strengths and weaknesses, and each use different technology to scan bar codes, but both still end up producing the same results.

A 1-D scanner can only read 1-D bar codes, which are typically made up of straight vertical lines, and are the type you see on products at the store. The scan area will light up as a straight horizontal line when you point a 1-D scanner at a piece of paper. The scanner has to be lined up correctly with the bar code to read it, which in a healthcare setting could cause issues, like having to move a patient to get the right angle to scan their wristband. The only factor where 1-D scanners are better than 2-D scanners is cost, which in large facilities where many hundreds of scanners are required, can be significant.

A 2-D scanner can read both 1-D and 2-D bar codes, which usually look like patterns of little dots or squares, and are the ones you might have noticed in postmarks or in advertisements. The scan area will light up as a rectangle, or as a squiggly, twisting line when you point a 2-D scanner at a piece of paper. These scanners do not need to be perfectly aligned with the bar code, and can read them at almost any angle. Not long ago, 2-D scanners were much more expensive than 1-D scanners, which led to many facilities still having legacy equipment with 1-D scanners.

Other Technologies

There is a 3-D bar code, but we have never seen it in use on unit dose medications. The intent and purpose of a 3-D bar code is to make creating the physical bar code so hard and expensive that it deters counterfeiting, similar to the way holograms and special papers are used to protect currency. Identifying and validating diamonds is a situation where the cost and effort equals the benefits of 3-D bar codes. Potentially, pharmaceutical companies might use them to protect their supply chain from counterfeit medications, but we don't see 3-D going past the loading dock to the bedside or dispensing cabinet.

An RFID Tag is another technology that is gaining popularity in healthcare settings. These tags are encoded by a special printer, and they work very much like bar codes, with the advantage that they do not require line of sight to be scanned. This allows for systems that can inventory whole collections of items within range of the scanner, or systems that set off alarms if an item is moved past a scanner. While we see potential for RFID in identifying unit-dose medications in some cases, the cost and complexity still outweighs the benefits for tagging all medications at this time.

Bar Codes Types

Even if most of their scanners are 2-D, almost all of our customers only encode a 10 or 11 digit NDC without dashes in a 1-D bar code because it works well in the small space available on unit dose items. Plus, it's backward compatible for any equipment that only has a 1-D scanner. A small number of customers use 2-D bar codes to save space on the label, or use them because 2-D bar codes are more fault tolerant, which means they can handle more physical damage and still be readable. A very limited number of customers encode information like the NDC, Beyond-Use Date and Lot Number all in one bar code, and they can't do that in a 1-D bar code at the small size needed to fit on a unit dose item, so they use 2-D.

Within each type of bar code there are different bar code fonts. Just like *Arial* or *Times New Roman* in human readable fonts, the bar code fonts are just different ways to format the same information. Each one has features that make it better suited to specific purposes, like including check digits for verification of scans, or being better at small sizes, or even at really large sizes. For our customers, the most commonly used fonts are **Code 128** for 1-D bar codes, and **Data Matrix** for 2-D bar codes. Both of these fonts are very good at the small sizes needed to fit on unit dose labels, and they both return the same characters when read with a scanner.

Advanced Features

Some bar code fonts have "check digits" that a scanner will use to verify it read the whole bar code correctly. Scanners can also be programmed to change the encoded characters before passing them to the software, or to expect only certain types of information in a bar code, but we rarely see customers using these advanced settings in their scanner. More often, we see them program the scanner to send a "return key" or a "tab key" after each scan so the user doesn't have to press that button on their keyboard each time an item is scanned.

If a bar code is damaged and can't be read by the scanner, most bar code fonts will also include human readable text with the characters that are encoded in the bar code. When a bar code fails to scan, a person might be offered the option to type those characters in manually. Most programs make a note that the code was manually typed in for this transaction, and we have seen reports that have come back to pharmacy with information about bar codes that were hard to scan, or that had to be entered manually, so pharmacy can work to improve the physical quality of the bar

code and minimize these issues. Most commonly, these issues are caused by too much data for a small bar code size, or faded, worn out printing on the label.

Recommendations

Whenever we are asked for a recommendation on which scanner to buy, we always recommend customers use the same scanner that their facility uses at the bedside or dispensing machine that will ultimately be reading the bar codes they make. Each brand and model of scanner will have slight differences in tolerance, and the small bar codes required to fit on small labels could cross those tolerance lines. For almost every customer we have worked with, they test their finished unit dose items with the scanner and program that they will be using in the live environment to verify it matches the scan to the right item. If you do not currently use scanners in your facility, we use a **Symbol/Motorola/Zebra DS4208** for testing bar codes internally. The DS4208 is considered a reasonably good, inexpensive 2-D scanner.

In our MILT software, the Standard 1-D Template with a 10 or 11 digit NDC without dashes, encoded in a Code-128 1-D bar code, including human readable text, is the most commonly used configuration for our customers. MILT can be easily configured for 2-D bar codes. It can even encode up to seven pieces of information, including Application Identifiers that identify each piece, in one bar code, but this is only of value if your program knows what to do with that information when it's scanned.

Decision Time

This is the process we follow when we discuss picking a scanner and a bar code when the plan is to make bar codes to be read by bedside systems and dispensing equipment:

1. If the intention is to make bar codes for a specific system to read, use that same scanner and test the bar codes with that same system. If there is no specific system yet, use an inexpensive scanner like the Symbol/Motorola/Zebra DS4208. But, keep in mind that the system you end up using may not have a scanner as good as this one, so you should lean toward the simplest options below to minimize the risk of your bar codes not working when you do have a system. Going with the simplest possible option is also a good idea if you think you could merge with other facilities someday, because it will increase the odds that your bar codes will be compatible with their systems.
2. Determine the type of scanner you have by scanning a piece of paper. If it lights up a straight horizontal line, it is a 1-D scanner, and the only choice is a 1-D bar code. If it lights up a rectangular or squiggly, twisted area, it is a 2-D scanner, and you can use 1-D or 2-D bar codes. If you are buying your first scanner, go with an inexpensive 2-D type, like the DS4208 mentioned above.
3. Determine the type of information required in the bar code by the system that will be reading it. Remember, the purpose of a bar code is to pass information to the next system so it can perform a function for you. If that system doesn't want a Beyond-Use Date in the bar code, your encoding it will not make it a better bar code, and will probably make it harder to use that system. If it does want more than one piece of information, ask for the exact type of items, the expected order of those items, and if there needs to be Application Identifiers or codes that mark each item.
4. If you are only going to need a 10 or 11 digit NDC without dashes, a 1-D works well at the size required to fit on unit dose items. If you need more information encoded in the bar code, you may have to go with a 2-D bar code. Note that with most 1-D bar code fonts, alpha characters "weigh" more than numeric ones and make for denser, harder-to-scan bar codes. If you need one alpha character, 1-D may still work at the small size needed on unit-dose medications. If you need more than one alpha character, you may be pushed more

toward the 2-D bar codes because they are better able to store alpha characters without becoming too dense to scan.

5. With the above information collected, we usually recommend you go with the simplest option possible for your situation. Even if you have 2-D scanners, if you only need an NDC without dashes, the safest choice is a 1-D bar code. Using 1-D will cover you for that one dispensing cabinet you didn't realize people are still using, or that new facility your company just bought that has older equipment. This is not to say you shouldn't use 2-D. If you need more information encoded, or several alpha characters, or your bar coded items will not be handled with care and fault tolerance is a concern, or you will be labeling small vials with a tight circumference, and you are positive all your scanners are 2-D, then you may want to consider 2-D bar codes because they are, by design, a better technology.

Remember, the bar code is usually just a method for easily passing information to the next device or program in your system. While there might be bar code choices that seem like they have more power and options built into them, it is the bar code that is most universally readable and reliable in your environment that will unlock the magic! With this information in mind, you can determine the best bar code options to suit the needs of your system.

ABOUT MEDI-DOSE[®], INC. / EPS[®], INC. – For over 45 years, Medi-Dose / EPS has been working with pharmacists to develop cost-effective solutions that promote medication safety and error prevention.

800.523.8966 • MediDose.com • +1.215.396.8600

© (Copyright) 2017, Medi-Dose, Inc./EPS, Inc.